NEA Data Bank
Progress Report 2016-2017

NRDC Meeting, Vienna, Austria
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1. General

The Data Bank (DB) of the OECD Nuclear Energy Agency (NEA) provides scientists in participating countries with reference materials in the field of nuclear energy applications. The services include the compilation, verification, and distribution of nuclear data, chemical thermodynamic data, integral benchmark experiments, as well as computer programs and associated application libraries. The Data Bank also develops and maintains databases and related administration/retrieval tools, including the JANIS display software. The Data Bank staffs work in close co-operation with the secretaries of the Nuclear Science (NS) Working Parties (WP), especially in the field of computer codes and libraries benchmarking, integral experiments, nuclear data evaluation, and knowledge preservation. These activities are in essence international and organised in close collaboration with other main national and international organisations.

More information on the NEA Data Bank can be found at www.oecd-nea.org/databank.

2. Organisation

The Data Bank's current list of participating countries consists of 25 countries in Europe, North America (Mexico), Russia and the Asia-Pacific region.

The **DB Task Force** (TF) was established to discuss future NEA DB activities and prepare the next NEA strategic plan 2017-2022. The TF review and discussion concluded in a set of recommendations for the Executive Group of the Nuclear Science Committee (June, 2015) to improve NEA/DB services and functioning. These recommendations could be summarized in the following four strategic initiatives: improvement of client services, adapting to new technical developments, enhancing scientific expertise, and enhancing governance.

Originating from the Recommendations of the Task Force on the Future Programme of the Data Bank, the NEA Steering Committee has approved the proposal to modify the name, reporting line, and mandate of the Executive Group of the NSC (Data Bank Management Committee). The EG-NSC has been renamed "Management Board on the Development, Application and Validation of Nuclear Data and Codes", or "**MBDAV**". The new MBDAV reports directly to the Steering Committee rather than to the Nuclear Science Committee. These changes, along with the new mandate, represent an important first step towards enhancing the Data Bank's governance structure and visibility.

The Data Bank is composed of **10 staffs** working on both Data Bank and Nuclear Science related activities (plus additional NEA related activities when relevant). In addition 2 staffs of NEA/IT Services are contributing to NRDC activities. In total, **one full-time equivalent man-year** is allocated to these activities.

3. Nuclear Data Services

The Data Bank maintains large databases containing evaluated, experimental and bibliographic data and makes them available online to scientists and engineers in its participating countries. Other important nuclear data related activities of the Data Bank are the coordination of the Joint Evaluated Fission and Fusion (JEFF) file project and the development of the JANIS software, designed to facilitate the visualisation, comparison, and manipulation of nuclear data.

More information on Nuclear Data Services can be found at www.oecd-nea.org/dbdata.

- An overview of NEA activities has been presented in JEFF-Nov. 2016 Meeting: *"JEF/DOC-1777: EXFOR: status and new developments, overview of NEA activities", O. Cabellos.*

3.1 Experimental data compilation

The Data Bank compilation of measured neutron and charged particle induced reaction data continues with the help of external consultants. Continuous efforts are made to check the content of the database and retransmit corrected entries.

Neutron induced data (Area 2): In 2016, 42 new and 187 updated entries were compiled by the Data Bank for area 2. In the first months of 2017, the corresponding figures are 70 new and 133 revised entries.

Charged particle induced data (Area O): In 2016, the Data Bank compiled 22 new entries and 97 updated entries for area O. The corresponding figures for the first months of 2017 are 43 new and 56 revised entries.

Table 2 shows more detailed statistics of recent NEA transmissions.

Table 2. Number of NEA's EXFOR entries since 2012.

Year	Trans	Entry	
		New	Updated
2012	Total	133	238
2013	Total	104	224
2014	Total	90	286
2015	Total	107	78
2016	2243 (Feb 2016)	0	40
	2244 (Feb 2016)	15	5
	2245 (May 2016)	0	51
	2246 (May 2016)	0	33
	2247 (May 2016)	4	20
	2248 (May 2016)	12	3
	2249 (Aug 2016)	9	14
	2250 (Aug 2016)	2	7
	2251 (Sep 2016)	0	14
	o055 (May 2016)	20	6
	o056 (May 2016)	0	75
	o057 (May 2016)	2	3
	o058 (Oct 2016)	0	13
	Total	64	284
2017	2252 (Jan 2017)	0	40

(1st half)	2253 (Jan 2017)	36	0
	2254 (Feb 2017)	9	8
	2255 (Feb 2017)	3	24
	2256 (Mar 2017)	12	3
	2257 (Mar 2017)	0	20
	2258[1]	5	16
	2259[1]	5	22
	o059 (Jan 2017)	0	2
	o060[1]	43	2
	o061[1]	0	52
	TOTAL	113	189

3.2 JEFF project

The **Joint Evaluated Fission and Fusion File** (JEFF) project is a collaboration between NEA Data Bank participating countries to produce common sets of evaluated nuclear data, mainly for fission and fusion applications. The library contains a number of data types, including neutron and proton interaction data, radioactive decay data, fission yields and thermal scattering law data.

The latest version of the neutron cross-section JEFF library, JEFF-3.2, was released in March 2014. JEFF-3.2 is a major update of the general purpose neutron library which contains, in particular, new evaluations of neutron data for actinides, more complete gamma production data and has been revised and expanded to include neutron data for 472 nuclides or elements. JEFF-3.2 data are available on the NEA website at www.oecdnea.org/dbdata/jeff.

The current mandate of the JEFF project (2015-2018) is aimed at delivering JEFF-3.3. JEFF-3.3 will include a revision of all files in the library, which now includes neutron data in ENDF-6 format for over 560 nuclides or elements. In particular new evaluations of actinides are proposed. JEFF-3.3 will include updated Decay Data and Fission Yields libraries, new or revised Thermal Scattering Law data files for several compounds are also foreseen.

In 2016, NEA has continued the developments which have strengthened the technical capabilities of the Data Bank in the areas of evaluated nuclear data testing, processing, benchmarking and validation. These developments are directed at developing a modern Q&A approach for managing nuclear data files and libraries, an activity which –as a whole- had not previously been part of the Data Bank nuclear data services. This work is seen as a very welcome development by the nuclear data community. For instance, the development of the NDEC platform (Nuclear Data Evaluation Cycle) which aims at establishing, as part of Data Bank's enhanced nuclear data, a centralized and automatized service to perform the different steps for the verification and validation of nuclear data.

The proposed NDEC aims at improving the transparency and visibility of the whole process of the production of a well-documented nuclear data library. It implies developing increased nuclear data services provided systematically by the Data Bank, built around already existing NEA tools (JANIS, ICSBEP/DICE, etc…) and implementing new ones, in a collaborative working environment. Data Bank is also working in a sub-versioning system to keep traceability of submitted files.

3.3 JANIS software

The JANIS software allows the user to display and compare evaluated and experimental nuclear data from large international databases (e.g. JEFF, ENDF/B, JENDL, EAF, CENDL, BROND, TENDL for evaluated data, and EXFOR for experimental data). A new version of JANIS was released online and

[1] Status=PRELIM

on DVD in September 2013. JANIS 4 introduces a Web interface, as well as major new features to display fission yields on 2D colour maps, to plot, tabulate and compare user's data in simple text format, as well as the possibility to save and restore JANIS state (plot, table, settings, etc.). More information on JANIS can be found at www.oecd-nea.org/janis.

- JANIS activities were presented *in the International Conference on Nuclear Data for Science and Technology, ND2016, 11-16 Sep. 2016, Bruges, Belgium*. The main new feature in JANIS is the scripting capability via command line, which notably automatizes plots generation and permits automatically extracting data from the JANIS database. Recent NEA software developments rely on these JANIS features to access nuclear data, for example the Nuclear Data Sensitivity Tool (NDaST) makes use of covariance data in BOXER and COVERX formats, which are retrieved from the JANIS database.

The Data Bank also develops in-house codes to help check the correctness of EXFOR data. These codes are based on the JANIS software and use EXFOR dictionaries. They are used at the Data Bank to peer review EXFOR files submitted to NRDC as well as the EXFOR Master file shared among Data Centres. A standalone version of the JANIS Trans checker has been integrated into other EXFOR tools: 1) the EXFOR compilation tool at the Hokkaido University Nuclear Reaction Data Centre (JCPRG) at http://www.jcprg.org/exfor/tool/, and 2) the EXFOR-Editor developed at VNIIEF. A Web version is available for online use at www.oecd-nea.org/janisweb/trans-checker.

In line with recommendations from WPEC Subgroup 30, new methods have been developed and implemented in Data Bank tools to cross-check experimental data (EXFOR) and evaluated data (e.g. JEFF) with the objective to further improve the quality of both databases:

- NEA Data Bank has worked to assess the quality of EXFOR data using a new statistical approach. The methodology has been applied to the most of the EXFOR neutron interaction data including threshold reactions, isomeric transitions and data in the resonance region. The methodology has been applied to natural elements, angular distributions and integral resonances:

  - This work has been presented in the International Conference on Nuclear Data for Science and Technology, ND2016, 11-16 Sep. 2016, Bruges, Belgium. The title of this work is *"Verification of the databases EXFOR and ENDF", G. Berton, G. Damart, O. Cabellos, B. Beauzamy, N. Soppera, M. Bossant.*

  - See also: *"JEF/DOC-1778 Verification of the EXFOR and ENDF Databases"*, G. Breton and O. Cabellos, JEFF Meeting, Nov. 2016.

- In-depth review of all threshold reaction cross-sections. See NEA/DB/DOC publications:

  - *"Statistical Verification and Validation of the EXFOR database: (n,n'), (n,2n), (n,p), (n,α) and other neutron-induced threshold reaction cross-sections"*, A. Koning, NEA/DB/DOC(2014)3.

  - *"Statistical verification and validation of the EXFOR database: (n,γ), (n,n'), (n,2n), (n,p), (n,α) and other neutron-induced reaction cross-sections"*, A. Koning, NEA/DB/DOC(2016)1, to be available in 2017.

3.4 Web services to nuclear data users

The online nuclear data services are now provided through direct access to the NEA databases taking advantage of the new Web interface of JANIS, which allows online browsing, searching and

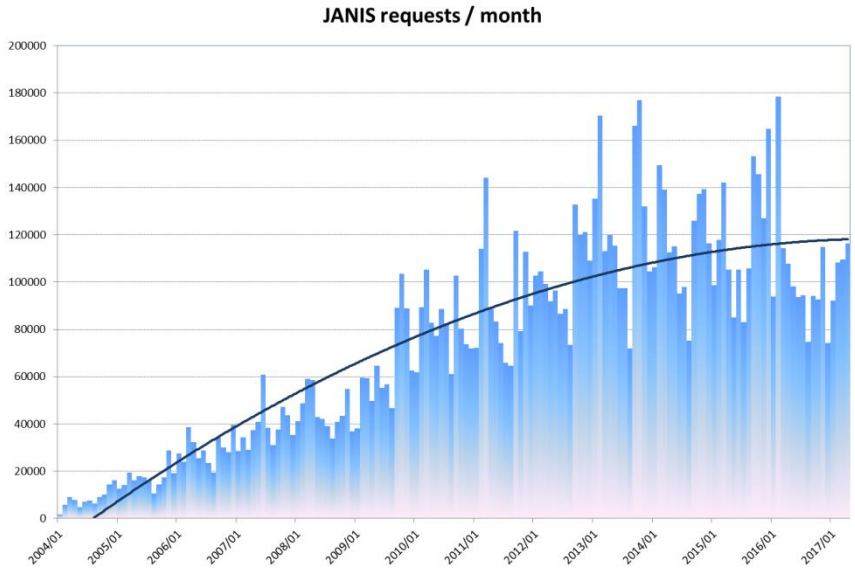
displaying nuclear data in a more user-friendly environment. The online services also include JANIS Books, comprehensive compilations of cross-section curves of experimental and evaluated data. JANIS Books are available for nuclear reactions induced by neutrons, photons and light-charged particles. Online Books are based on JANIS Web in order to allow the users to zoom in the plots, access complementary information and plot additional data. The statistics for online services are given in the following graph. The recent nuclear data libraries updated in the JANIS Books are TENDL-2015, FENDL-3.1b, BROND-3.1 and IRDFF-1.05.

Table 2. Nuclear Databases at the NEA/JANIS server.

Nuclear Properties	NUBASE-1997/2003/2012
Radioactive data	ENDF/B-VI.8/VII.0/VII.1, GEFY-3.2/3.3/4.2/5.2, JEF-2.2, JEFF-3.1/3.1.1 JENDL-4.0, JENDL-FPDD2000, JENDL/FPD-2011, JENDL/FPY-2011 TENDL-2010
Incident neutron data	EXFOR BROND-2.2/*3.1, CENDL-2.1/3.1 EAF-2007/.2010, ENDF/B-VI.8/VI.8-HE/VII.0/VII.1, FENDL-2.1/2.1MG/ *3.1b GEFY-3.2/3.3/4.2/5.2/5.3 IRDF-2002/2002MG, IRDFF-1.0/1.0640g/*1.05 JEF-2.2, JEFF-3.0/3.0A/3.1/3.1.1/3.1.2/3.2 JENDL3.3/4.0/HE* JENDL/AC-2008, JENDL/FPY-2011, JENDL/HE-2007, RUSFOND-2010 TENDL-2009/10/… /14/15 TSL-ENDF/B-VI.8, TSL ENDF/B-VII.0, TSL-JEFF3.0/3.1
Incident gamma data	EXFOR, ENDF/B-VII.0/VII.1, JENDL/PD-2004, TENDL-2009/10/…/14/15
Incident proton data	EXFOR ENDF/B-VI.8/VI.8-HE/VII.0/VII.1 JEFF-3.1, JENDL/HE-2007, JENDL-4.0/HE* PADF-2007 TENDL-2009/10/…/14/15
Incident deuteron and triton data	EXFOR, ENDF/B-VI.8/ VII.0/VII.1 TENDL-2009/10/…/14/15
Incident he3 data	EXFOR ENDF/B-VII.0/VII.1, TENDL-2009/10/…/14/15
Incident alpha data	EXFOR JENDL-AN-2005, TENDL-2009/10/…/14/15
Incident heavy particles, electron data, antiprotons, kaons(-,+) and pions(-,+)	EXFOR

Find out more about NEA nuclear databases at www.oecd-nea.org/dbdata/databases.htm.

Figure 1. Number of requests per month to the remote JANIS database since 2003.


JANIS requests / month
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2004/01
2005/01
2006/01
2007/01
2008/01
2009/01
2010/01
2011/01
2012/01
2013/01
2014/01
2015/01
2016/01
2017/01