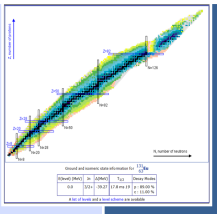
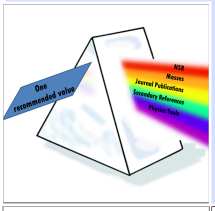
BNL-228046-2025-INRE

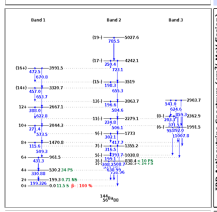


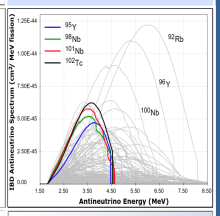
United States Nuclear Data Program

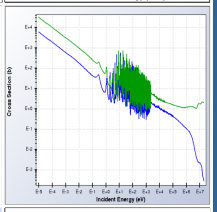
Annual Report for Fiscal Year 2024

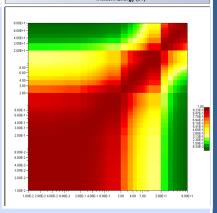
This document describes the activities including related metrics performed by the US Nuclear Data Program members during Fiscal Year 2024.











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and the entire USNDP

www.nndc.bnl.gov/usndp

BNL

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I. Introduction

The US Nuclear Data Program (USNDP) Annual Report for Fiscal Year 2024 (FY24) summarizes the work of USNDP for the period of October 1, 2023 through September 30, 2024, with respect to the Work Plan for FY24 that was prepared in 2022. The Work Plan and Final Report for USNDP are prepared for the DOE Office of Science, Office of Nuclear Physics. The support for the nuclear data activity from sources outside the nuclear data program is described in the staffing table and in Appendix A. This leverage amounts to about 14.8 FTE scientific, to be compared with 13.9 FTEs at USNDP units funded by the DOE Office of Science, Office of Nuclear Physics. Since it is often difficult to separate accomplishments funded by various sources, some of the work reported in the present report was accomplished with nuclear data program support leveraged by other funding.

The FY24 Work Plan developed by the US Nuclear Data Program participants. The program continued to carry out important work in support of the DOE mission. The work balances the ongoing collecting, analyzing, and archiving of nuclear physics information critical to basic nuclear research and to the development and improvement of nuclear technologies with the electronic distribution of this information to users in a timely and easily accessible manner. The present section of the report consists of activity summaries for the major components of the USNDP. This is followed by an updated staff level assignment table that reflects the final distribution of effort among the tasks carried out during FY24. Then, we continue with the detailed status of work performed during FY24.

In terms of personnel changes, the USNDP has undergone several changes in FY24:

- Rikel Chakma joined ANL in February 2024 as a post-doc to work on AME and NUBASE
- Soumen Nandi (FOA-funded post doc) left ANL for a post-doctoral position at the Université de Nantes, France
- Allan Carlson's contract was paused through FY24
- E.J. Gass (contractor) is no longer a contractor of the NNDC
- Stanislav Hlavac (contractor) passed away in July 2024
- Samuel Kim has left the NNDC for a post-doctoral position at LANL in the isotopes production group
- Otto Schwerer's contract was paused through FY24
- JoAnn Totans retired in December 2024
- Sanjanee Waniganeththi joined the NNDC on April 1st as a post-doc to work on the Accelerated Decay Data Evaluation project
- Mathis Wiedeking joined LBNL as Career Staff in 2024
- Ian Thompson retired from LLNL
- Andre Sieverding is now the PI for the USNDP project at LLNL
- Jaspreet Randhawa left LANL for an assitant professor position at Mississippi State University in Aug. 2024

- Michael Smith retired from ORNL in September
- Augusto Macchiavelli will serve as interim PI for the USNDP project at ORNL in FY25

Table 1 summarizes the USNDP metrics since 2001. Table 2 shows the breakdown of the metrics by laboratory for the reported fiscal year and comparison with the previous fiscal year. The tables are followed by a definition of each metric and any comments pertaining to the metrics.

Table 1: Summary of the USNDP funding and metrics.

Fiscal year	USNDP funding ($K)	Change (%)	Compilations	Evaluations	Disseminations	Articles	Invited talks
2001			7,139	334	667	25	22
2002	4,890		6,159	300	799	40	22
2003	4,932	+0.9	4,975	260	966	40	23
2004	5,015	+1.7	6,241	276	1,212	36	43
2005	5,437	+8.4	6,623	422	1,642	59	42
2006	5,099	-6.6	4,936	318	1,863	60	48
2007	5,841	+14.6	5,355	366	2,239	56	51
2008	5,967	+2.2	5,104	385	2,996	72	68
2009	6,267	+5.0	4,047	400	3,294	61	56
2010	6,549	+4.5	4,662	395	2,843	83	51
2011	6,534	-0.2	4,662	479	3,252	96	67
2012	6,785	+3.8	5,221	209	3,013	90	48
2013	6,249*	-7.9	4,925	282	3,447	84	79
2014	7,032*	+12.5	3,738	166	3,411	107	81
2015	7,381*	+5.0	4,949	271	4,246	98	50
2016	7,597*	+2.9	3,936	375	4,655	82	72
2017	6,953	-8.5	3,684	404	4,730	95	51
2018	8,496[a]	+22.2	4,097	221	4,722	79	58
2019	8,797[b]	+3.5	3,663	203	5,148	67	60
2020	9,344[c]	+6.2	3,603	159	5,678	63	49
2021	9,435[d]	+0.99	5,380	273	7,297	71	59
2022	10,290[e]	+9.06	3,988	292	9,016	71	71
2023	10,433[f]	+1.4	4,245	181	13,200	71	84
2024	10,245[g]	-1.8%	3,172	192	13,071	77	70

*: It includes $500K of Early Career Award (LANL).

a: It includes the following (a) FIRE collaboration funding $100 (LLNL), (b) LAB17 call funding: $325K (ANL), $220K (LANL), (c) LAB18 call funding $26K (ANL), $282K (BNL), $120K (LANL), $75K (LBNL), $100K (LLNL), $372K (ORNL).

b: It includes the following (a) FIRE collaboration funding $100 (LLNL), (b) LAB17 call funding: $325K (ANL), $220K (LANL), (c) LAB18 call funding $27K (ANL), $289K (BNL), $120K (LANL), $75K (LBNL), $50K (LLNL), $373K (ORNL), (d) WANDA organization: $25K (ORNL).

c: It includes the following (a) FIRE collaboration funding $100 (LLNL); (b) LAB calls funding: $354K (ANL), $619K (BNL), $120K (LANL), $75K (LBNL), $50K (LLNL) and $375K (ORNL); (c) WANDA organization: $150K (ORNL) and $20K (LLNL).

d: It includes the following (a) FIRE collaboration funding $100 (LLNL); (b) LAB calls funding: $884K (ANL), $717K (BNL), and $173K (ORNL).

e: Includes LAB calls funding: $825k (ANL), $693k (BNL), $702k (LANL), $61k (LLNL), and $424k (ORNL).

f: Includes LAB calls funding: $293k (ANL), $600k (BNL), $836k (LANL), $344k (LBNL), $64k (LLNL), $772k (ORNL) and $113k (PNNL).

g: Includes LAB calls funding: $176k (ANL), $602k (BNL), $821k (LANL), $344k (LBNL), $66k (LLNL), $930k (ORNL) and $149k (PNNL).

Table 2: USNDP metrics in the last two fiscal years, numbers from the previous fiscal year are shown for comparison.

Laboratory	Compilations		Evaluations		Disseminations (in thousands)		Articles		Invited Talks	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
ANL	2	2	13	13	-	-	17	18	9	6
BNL*	4,184	3,091	128.4	76.5	10,931**	12,080	20	15	33	34
LANL	-	-	2.8	10.7	-	-	15	13	15	14
LBNL	0	0	16	24	24	24	17	16	13	9
LLNL	-	-	15	12	-	-	0	2	2	1
MSU	30	34	24	40	-	-	7	7	2	1
ORNL	-	-	13	11	2,168	867	7	3	9	3
TAMU	-	-	17	18	-	-	1	2	0	2
TUNL	37	53	2	3	77	100	1	1	1	0
Total	4,245	3,185	231	208	13,200	13,071	71	77	84	70

*: BNL compilations consist of (a) 2,600 NSR articles, including keywords for 1,781 of them; (b) 190 articles for EXFOR; (c) 301 articles encompassing 568 XUNDL datasets. BNL evaluations consist of (a) 52 nuclides for ENSDF and 24.5 for ENDF/B. For the remaining groups, all compilations are for XUNDL, while all evaluations are either ENSDF (ANL, LBNL, MSU, ORNL and TAMU) or ENDF/B (LANL, LLNL).

**: BNL's FY23 values were revised downward from the values reported in the FY23 Annual Report because they included 1.936M NSR retrievals from bots.

Metric definitions and comments:

1. **Compilations**: The sum of the new entries added to the USNDP bibliographic (NSR - articles) and experimental databases (EXFOR - reactions, XUNDL - structure data sets). The compilation activities are on a healthy situation, and these databases are updated regularly with newly published material.
2. **Evaluations**: The sum of new evaluations submitted or accepted for inclusion in the USNDP evaluated nuclear databases. For ENSDF, it is the number of evaluated nuclides, while for ENDF, it is the number of evaluated reactions/covariances. There were 145 ENSDF evaluations and 47 ENDF/B evaluations submitted. The number of ENSDF evaluations remains well below the number needed, about 340, to evaluate each of the ENSDF nuclides on average every 10 years.
3. **Dissemination**: The number of electronic data retrievals made from USNDP maintained web sites. Data retrieval is defined as a request for data from any of the databases that receives a result. Total pages accessed is not tallied.
4. **Articles**: The number of articles published in refereed journals. The number of articles per FTE has remained relatively constant in the last few years, but the number of FTEs in the USNDP has grown. A selected list of articles published is given in the Appendix C.
5. **Invited talks**: The number of presentations given at the explicit invitation of the organizers of conferences, symposia, workshops, and training courses. The number of invited talks has not changed significantly from last year's value.

II. Network Coordination and Data Dissemination

The National Nuclear Data Center (NNDC) continues to serve as the core facility of the U.S. Nuclear Data Program (USNDP). It has the main responsibility for national and international coordination, database maintenance, and data dissemination. However, other program participants are also involved in coordination and dissemination activities.

National and International Coordination

The NNDC serves as the secretariat for the US Nuclear Data Program and has prepared the Work Plan for this fiscal year in cooperation with the members of the Coordinating Committee. The NNDC Head serves as the chair of the USNDP Coordinating Committee, which consists of the Principal Investigators from each of the participating group and chairs the annual meeting of the program during Nuclear Data Week. This year, Nuclear Data Week was held from November 13-17, 2024. A representative from LANL chairs the Nuclear Reaction Data Working Group, and a representative from TUNL chairs the Nuclear Structure Working Group. ORNL chairs the Astrophysics Task Force through FY24, and with the retirement of Michael Smith, the USNDP will revisit the organization of this Task Force.

On February 13, 2024, the DOE Office of Nuclear Physics conducted its annual Budget Briefing. Lee Bernstein, David Brown, Jun Chen, John Kelley, Filip Kondev, Hye-Young Lee, Ninel Nica, Gustavo Nobre, Gregory Potel, Sofia Quaglioni, Elizabeth Ricard, Martin Schoonen, Michael Smith, and Alejandro Sonzogni represented USNDP and made the case for the FY26 funding.

The NNDC serves as the focal point for U.S. collaboration in international nuclear data activities. This collaboration continued both in nuclear structure and decay data (Network of Nuclear Structure and Decay Data Evaluators, NSDD) and reaction data (NEA Working Party on International Nuclear Data Evaluation, WPEC, and Network of Nuclear Reaction Data Centers, NRDC).

The NNDC also chairs the Cross Section Evaluation Working Group (CSEWG), which produces the ENDF/B evaluated nuclear data library for nuclear science and applied nuclear technology use. The 2024 CSEWG Meeting was hosted by BNL as part of the 2023 Nuclear Data Week. This meeting focused on the final preparations of the ENDF/B-VIII.1 library which was subsequently released in August 2024.

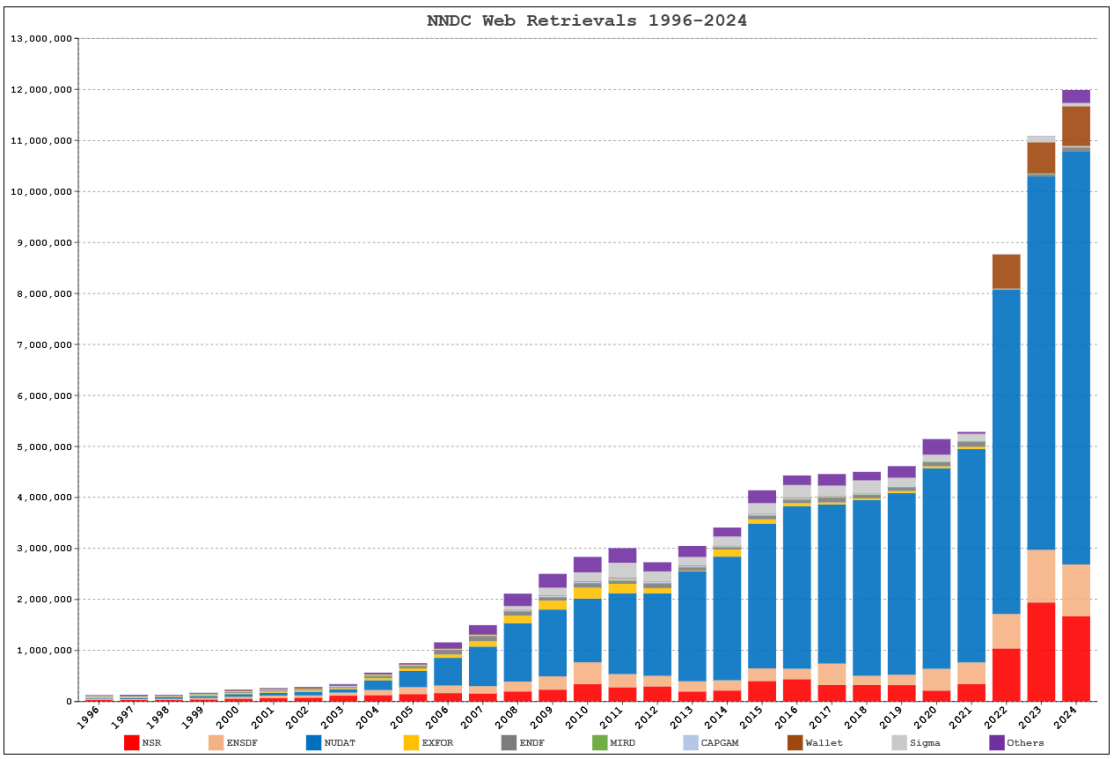
The USNDP also continues to play a leading role in the annual Workshop for Applied Nuclear Data Activities (WANDA) conference series, with the inaugural workshop held in Crystal City, VA in 2024 organized by LBNL. WANDA 2024 focused on nuclear data issues pertinent to fusion energy.

USNDP Databases

NNDC maintains the collaboration GitLab collaboration platform (git.ndc.bnl.gov) in order to facilitate data and codes development and keep track of changes. The NNDC maintains seven nuclear physics databases for USNDP, which were updated continuously this fiscal year with new and revised information from efforts of the NNDC, USNDP and international collaborators. Distributions of all or parts of these databases have been made to national and international collaborators as scheduled.

Data Dissemination

There were 13 million database retrievals this fiscal year USNDP-wide. This includes a 11% increase in BNL retrievals and that is somewhat offset by the decrease in retrievals at ORNL. Most of the retrievals, 92%, were from the NNDC web site, with NuDat as the most popular product.



Major Publications

The NNDC continues to publish the refereed journal Nuclear Data Sheet with six issues published this fiscal year.

III. Nuclear Structure and Decay Data

The nuclear structure working group emphasizes the evaluation of measured nuclear structure and decay properties for all isotopes. These data are maintained at the NNDC in the Evaluated Nuclear Structure Data File (ENSDF). Production of ENSDF is an international effort operating under the auspices of the IAEA Nuclear Structure Decay Data (NSDD) network. ENSDF is an important source of information for derivative databases and applications, including NuDat, Nuclear Wallet Cards, RIPL, MIRD and ENDF/B. Evaluations are published as peer-reviewed articles in the Nuclear Data Sheets. The Nuclear Science Reference (NSR) and Experimental Unevaluated Nuclear Structure Data List (XUNDL) databases have been kept current. The combination of ENSDF and XUNDL databases represents a nearly complete literature coverage of experimental nuclear structure data, which is a salient feature of these databases.

Status of ENSDF

ENSDF evaluations of 145 nuclides were submitted for inclusion into the database. These evaluations included recommended properties for 7348 Levels and 9896 Gammas. 12 mass chains were reviewed by the network for consideration for publication in the Nuclear Data Sheets journal.

Status of XUNDL

Based on regular scanning of nuclear physics journals, 674 datasets were compiled from 382 articles. The project to compile and carry out physics checks on the data from nuclear structure manuscripts submitted to Phys. Rev. C and European Physical Journal A continues.

Status of NSR

In FY2024, 2,600 new articles were added to the NSR database. USNDP contributions are from B. Pritychenko (manager), C. Dunn, B. Shu, and D. Symochko (NNDC), with international input from L. Vrapcenjak (IAEA). The database is current and in good shape. The number of NSR web retrievals was 1,669,092, a substantial increase from last year that is likely due in part to the transition to Google Analytics for metrics capture.

Horizontal Evaluations and Other Data Related Activities

A summary list of "Horizontal Evaluations and Other Data Related Activities" involving USNDP structure evaluators includes the following:

- IAEA-CRP evaluation of fission yields: A. Sonzogni, A. Mattera, E. Ricard, B. Pritychenko, T. Kawano, F.G. Kondev – continuing.
- The Atomic Mass Evaluation (AME) and the evaluation of basic nuclear physics properties for ground states and isomers (NUBASE): F.G. Kondev – continuing.
- Modernization of ALPHAD-radD analysis code: A new Java code AlphaHF was developed and completed to replace the legacy ALPHAD-radD fortran, which uses even-even r0 parameters from 2020Si16 in NDS. Update of r0 parameter to include new papers on even-even alpha decays and

to incorporate data in AME2020 is continuing. The updated evaluation of alpha-decay data for even-even nuclei, and anticipated publication of a paper on updated r0 parameters is being done. J. Chen in collaboration with Drs. S. Singh and S. Kumar, Akal University, India – continuing.

- IAEA-led decay data library for monitoring applications: J. Chen, F.G. Kondev, J. Tuli – continuing.
- Compilation of B(E3) experimental data for inclusion into the new topical evaluation on B(E3) transition probabilities. F.G. Kondev in collaboration with a data scientist from the Australian National University.
- IAEA-CRP on Delayed Neutron Emission Probabilities: Reference database at IAEA-NDS: E. Ricard.
- WalletCraft: Object-oriented database for ground and long-lived isomeric properties: E. Ricard, B. Shu, D. Mason, C. Morse, S. Ota, J. Wu, A. Mattera continuing.
- Update of 2000Am02 magnetic dipole rotational bands. A paper is under preparation for submission. Searching for new USNDP leadership: J. Chen is interested.
- B(E2) project for first 2+ and 4+ states of all the even-even nuclei: continuing to compile B(E2) values with a plan to provide a set of evaluated, recommended values. B. Pritychenko.
- Gamma-ray transition probabilities for all experimentally known multipolarities for all the nuclei: update of Endt's work of the 70's. This project started recently and will take two-three years to complete. J. Chen
- "Two-neutrino mode Double-beta Decay Half-Lives Evaluation: Double-beta decay data for 14 parent nuclei have been reviewed and USNDP FY2023 Report Page 10 recommended T1/2 and nuclear matrix elements were produced." This work is completed and was published in January 2024. B. Pritychenko and V.Tretyak (KINR, Ukraine)

Status of ENSDF Codes

Jun Chen continues developing new and maintaining existing analysis and utility Java codes used by ENSDF evaluators, and he is implementing modern programming for legacy codes.
Updates and improvements continue for the McMaster-MSU **JAVA-NDS** code that has been used both to produce print-ready documents for the Nuclear Data Sheets and for retrievals of ENSDF data sets at the NNDC website.

The Java toolkit **ConsistencyCheck** has been developed and completed to ensure evaluation consistency and facilitate evaluation process, and updates and improvements for this code continue.

Java-RULER, a replacement for the legacy FORTRAN **RULER** program, has been developed. The utility code is used for calculating transition strengths with an improved Monte Carlo approach for error propagation for large and asymmetric uncertainties. Updates and improvements for this code continue.

A new Java code called **GLSC** (Gamma to Level Scheme Computation) has been developed to replace the legacy **GABS** and **GTOL** codes. The Java code has improvements and offers new interactive features for fitting gammas in a level scheme, for calculating level feedings, and for calculating absolute gamma emission probabilities within decay datasets. New functions have been added, such as automating the

creation of the final decay dataset with newly calculated decay feedings and absolute gamma emission probabilities.

The AME-NUBASE viewer has been developed to provide easy and customized retrieval of AME (Atomic Mass Evaluation) and NUBASE (evaluation of ground-state and isomer properties) entries and also to automatically update all Q records in the adopted datasets and all parent Q values in the decay datasets in an input ENSDF file with the latest AME values. It can also be used to perform simple arithmetic operations on AME masses using nuclide names, which is a useful and convenient tool when calculating a new Q-value from AME masses and newly measured masses.

The **KeynumberCheck** code has been developed to check NSR key-numbers in ENSDF datasets for format errors, irrelevant or nonexistence by searching in an input list of key-numbers or in the NSR database directly. The same checking function has been also included in the ConsistencyCheck toolkit.

The **FormatCheck** code has been developed to replace the legacy FMTCHK Fortran code which lacks maintenance and has only limited checking capabilities. This new Java code is designed to check all possible format errors in ENSDF datasets. Updates on the list of possible format errors continue.

The **Excel2ENSDF** code has been developed initially for converting an Excel file with formatted data to an ENSDF dataset. It is widely used by XUNDL compilers and ENSDF evaluators when compiling tabulated data and making a dataset out of a paper. The function of the reverse conversion from an ENSDF dataset to an Excel file has also been developed to help merge the existing data in a dataset with other tabulated data.

The **RadiationReport** code has been developed to calculate energies, intensities, and doses of all radiations as well as logft values for a decay dataset. It is an alternative to the **RADLIST** and **LOGFT** Fortran codes combined. It can calculate logft values for forbidden-unique decays with order>2 which are calculated incorrectly as allowed decays by the legacy **LOGFT** code. A stand-alone GUI tool (**LogftCalculator**) for calculating the logft value for a single beta-decay branch based on user inputs has also been developed and is wrapped in the NNDC logft webpage as an online logft calculator for researchers.

The **AlphaHF** code has been developed to calculate Hindrance Factor and nuclear radius parameter R0 for alpha decay. It is intended to replace the legacy **ALPHAD_RADD**, **ALPHAD**, and **RADD** Fortran codes.

All codes and their recent updates have been presented in the 2024 USNDP meeting. Discussions during the USNDP meeting have motivated new updates in the codes and the process for code distribution. Updates and improvements as well as developments of other new utility and analysis codes to help streamline, automate and speed up the evaluation workflow and further improve the evaluation efficiency and productivity are underway.

IV. Nuclear Reaction Data

The nuclear reaction data effort focuses on evaluation of nuclear reaction data and the related measurement and compilation activities. The capstone of this effort is the creation of the ENDF/B nuclear data library by the Cross-Section Evaluation Working Group (CSEWG) which is chaired by the chair of the USNDP. The USNDP also makes important contributions to nuclear reaction model code development, improvement of reaction cross-section standards and improvements to our understanding of photon strength functions.

ENDF/B-VIII.1 Release

The Cross Section Evaluation Working Group (CSEWG), with essential support from the DOE NP, is pleased to announce that the latest version of the US nuclear reaction data library, ENDF/B-VIII.1, has been released to the broad nuclear data community on August 30, 2024 (www.nndc.bnl.gov/endf-releases/). This is a major milestone in the history of the ENDF/B library, whose origin and importance can be traced back all the way to the end of the Manhattan Project. In this release, CSEWG made many significant updates to the major and minor actinides found in nuclear fuel as well as structural and other important materials. There are also important updates for the scattering of thermal neutrons off moderators, fuels, and special purpose materials, as well as for photo-nuclear reactions. During the development process, an integrated peer-review system was implemented, enabling CSEWG to find and solve issues before the release. This, allied with extensive validation, increased the quality and reliability of the final product, leading to being the best-performing library available, exemplified by Figures 1 and 2.

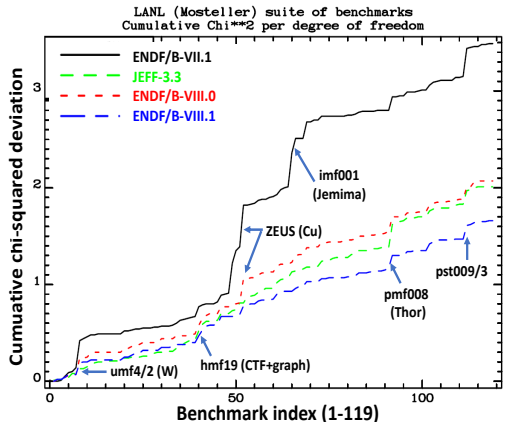


Figure 1: Cumulative chi-squared deviation between experimental integral criticality and the ones calculated from different libraries as a function of benchmark index in the Mosteller's suite, which is subset of the more than 2000 tests that were performed. We see that the most recent release, ENDF/B-VIII.1, significantly outperforms all of them and has the lowest cumulative curve.

All nuclear applications, from basic science and nuclear medicine to nuclear energy, reactor maintenance and design, nonproliferation, stockpile stewardship, and nuclear forensics, rely on accurate and reliable nuclear reaction data at their foundation. This data describes the nuclear interactions observed in nature with

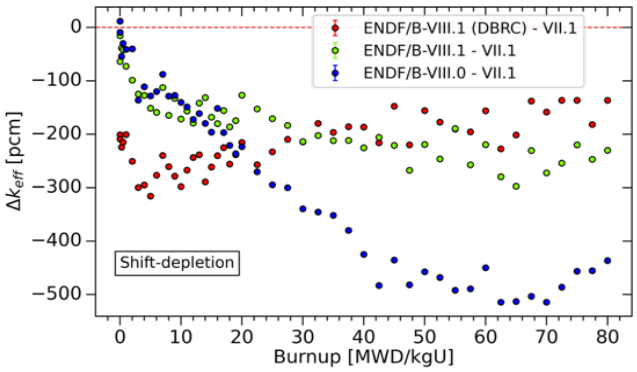


Figure 2: Depletion calculation for ENDF/B-VIII.1 and ENDF/B-VIII.0, subtracted by the ENDF/B-VII.1 performance. We see a dramatic improvement at high burnup, solving an issue introduced in the predecessor release that had prevented full adoption by the reactor community.

as much fidelity as possible, consistent with current experimental and theoretical knowledge. Such data are carefully assembled by nuclear data evaluators and packaged in data files that provide a complete picture of all relevant nuclear reactions and their relative probabilities, which are then distributed in nuclear data libraries through periodic releases, representing important updates on how nuclear data is understood. This work is the culmination of many years of efforts from high-skilled nuclear scientists who closely collaborated to deliver a scientific accomplishment that will impact nuclear data users for decades to come.

Nuclear Reaction Measurements

The Los Alamos National Laboratory (LANL) nuclear data team has been devoting a significant effort to upgrade the nuclear data of the actinide and structural material in ENDF both by conducting new experiments at Los Alamos Neutron Science Center (LANSCE) and by improving our nuclear reaction modeling capabilities in the Theoretical Division. We also closely collaborate with external experimental groups, such as Dr. Danon of Rensselaer Polytech. Inst., Dr. Grzywacz of U. Tennessee, Dr. Katabuchi of Tokyo Inst. Tech., and Dr. Kerveno of U. Strasbourg. These evaluation efforts are also leveraged by other nuclear data programs under DOE/NNSA. In FY24, we made progresses on reaction theory development by performing QRPA calculations for nucleon inelastic scattering with the noniterative finite amplitude method (FAM) and solving one-dimensional penetration problem for fission cross section calculation. New evaluations of ^{35}Cl have been completed in the fast energy range in close collaboration with LANSCE experimentalists and uranium isotopes (^{233}U, ^{234}U, ^{236}U, ^{237}U, ^{238}U and ^{239}U) were evaluated using consistent set of the fission barrier parameters.

The experimental efforts in FY24 focused on finalizing the differential cross sections of radioactive ^{40}K(n,$p_{0/1}$)^{40}Ar and ^{40}K(n,α_0)^{37}Cl reactions based on the new LENZ data performed at LANSCE. Experimental cross sections were compared with available evaluations and used for calibrating some of Hauser-Feshbach input parameters to reproduce the measurement data. As an additional effort in ENDF/B-VIII.1 release, the outgoing particle information was provided for differential cross sections of (n,p), (n,α), (n,d), and (n,^{3}He) reactions for 55 isotopes using the Hauser-Feshbach code, CoH3. For iron and nickel elements, the LENZ experimental data were used to evaluate outgoing charged particle's angular distributions and energy spectra for neutron energy from threshold to 20 MeV.

Nuclear Reaction Models

The software CoH_3 package, which supports the USNDP and its community, was released as open source by LANL. CoH_3 calculates comprehensive nuclear reactions in keV to MeV energy range using the coupled-channels Optical Model and statistical Hauser-Feshbach theory with the pre-equilibrium process and is available at https://github.com/toshihikokawano/coh3.

In FY24, G. Potel Aguilar from Lawrence Livermore National Laboratory has worked on the connection to R-matrix theory, which is essential for understanding the energy-dependent cross sections of direct nuclear reactions to indirect measurement. A published report [LLNL-TR-869017] delves into the formalism of elastic and inelastic scattering, the role of the optical potential, and the application of Green's Function Transfer (GFT) formalism in indirect reactions. The report also explores the limitations

of the spectator approximation and suggests methods to account for higher-order effects beyond this approximation.

Quasi-continuum data compilation

Photon strength functions (PSFs), which describe the average response of a nucleus to electromagnetic interactions, are crucial for the description of compound nuclear reactions. As such, they are relevant across a broad range of fields, including nuclear astrophysics, medical isotope production and for fission and fusion reactor technologies. PSFs also serve as inputs for widely utilized reaction libraries such as the IAEA Reference Input Parameter Library and evaluated databases like EGAF. The volume of gamma-ray data collected to determine PSFs from a wide range of experimental techniques has grown in recent years and will continue to grow substantially. In parallel our theoretical understanding, which informs the global models for PSFs, has been improved significantly. These advances were consolidated and published through an IAEA Coordinated Research Project in 2019. The collection and assessment of PSF data continues and in 2024, a major update was performed to incorporate the significant amount of new experimental PSF data which have become available from recent experiments. In addition, a new graphical user interface was developed, facilitating user-friendly access and versatile plotting capabilities to these PSF data. https://www-nds.iaea.org/PSFdatabase/

Nuclear Astrophysics

LANL team made progress on computing the astrophysical impacts of ^{40}K production puzzle based on the experimentally deduced reaction rates from the LANSCE measurements. In comparison to REACLIB, both rates were used to perform the core-collapse supernova simulations for 15 solar mass and 20 solar mass in order to explore the ^{40}K yield variations. This work is in collaboration with Dr. Pignatari and Dr. Roberti from the Konkoly Observatory in Hungary.

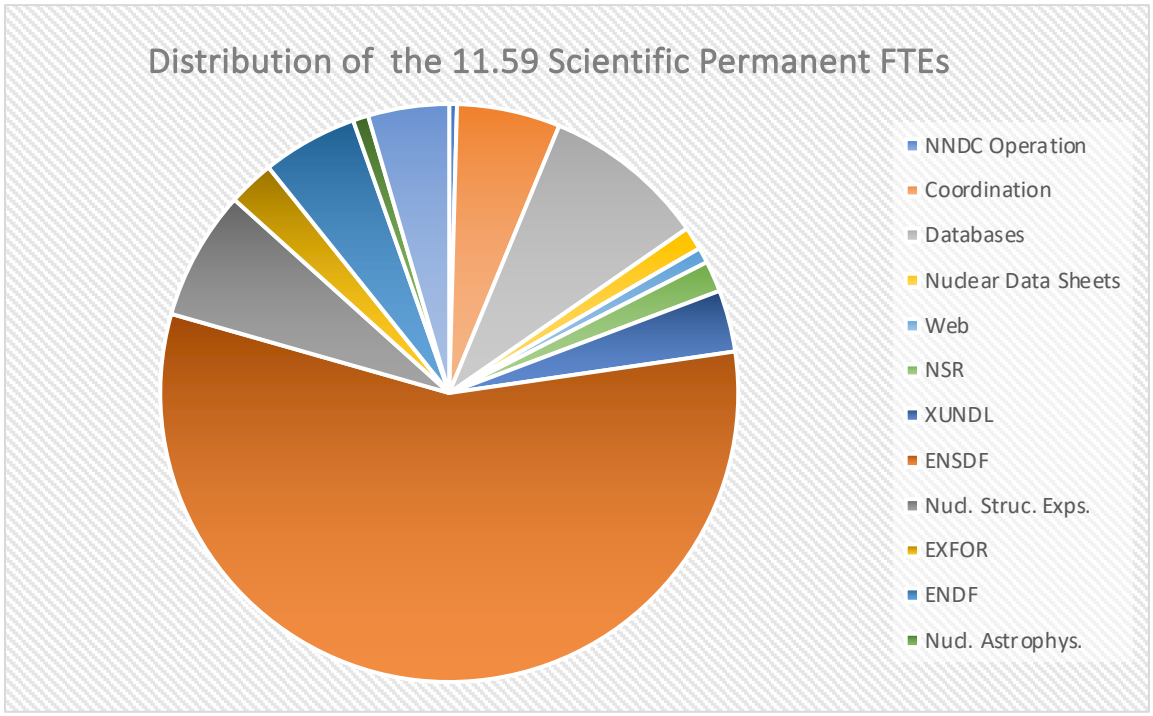
USNDP Staffing Table FY 2024

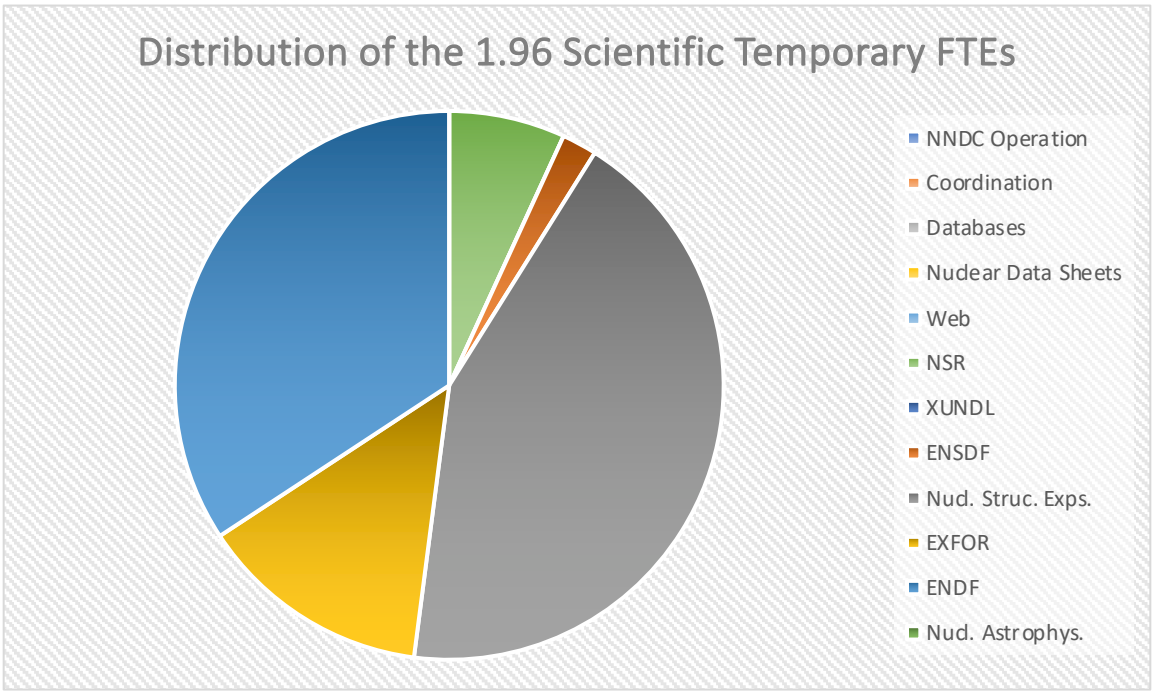
The table below gives the FTE distribution for each USNDP group according to activity. The values in this table and following plots are for the based funding only. In this table, PhD P means PhD Permanent; PhD T means PhD Temporary, which includes post-docs and scientists working under contract; T/A means Technical and Administrative; and GS means Graduate Student.

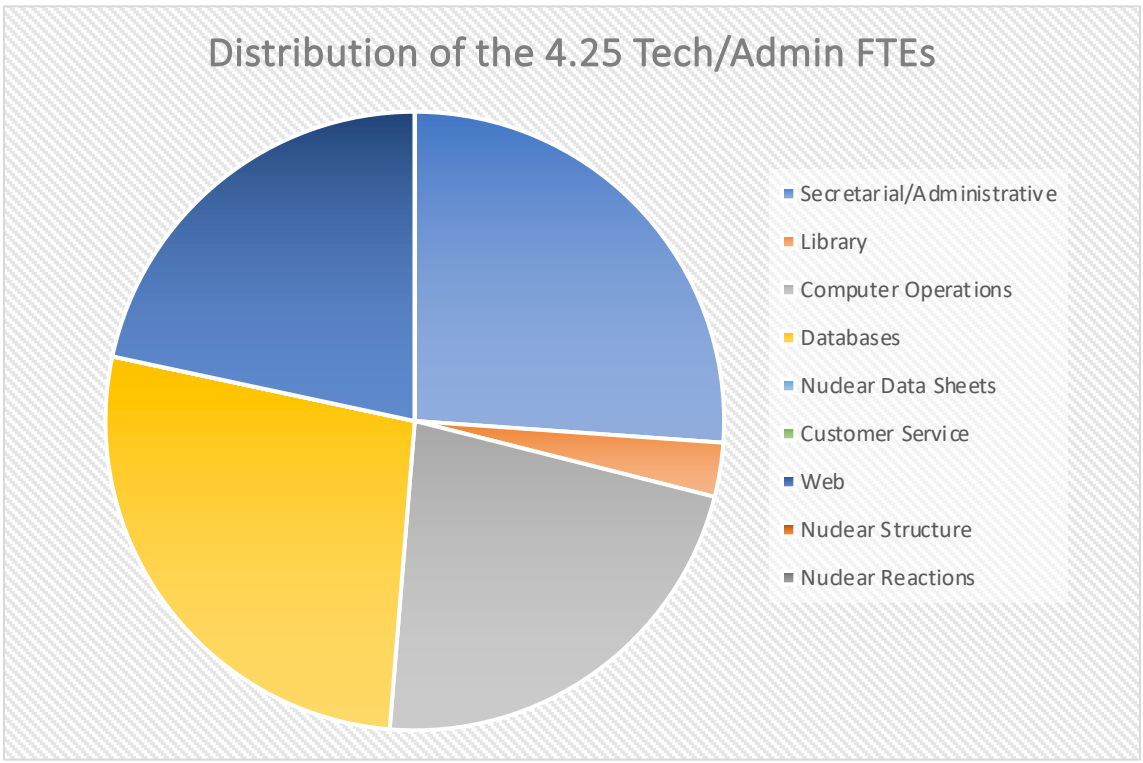
Activity	ANL	BNL			LANL			LBNL		LLNL	MSU	ORNL		TAMU	TUNL		
	PhD P	PhD P	PhD T	T/A	PhD P	PhD T	GS	PhD P	PhD T	PhD P	PhD P	PhD P	GS	PhD P	PhD P	PhD T	Totals
I. NNDC Facility Operation	0	0.05	0	2.18	0	0	0	0	0	0	0	0	0	0	0	0	2.23
Management		0.05															0.05
Secretarial/Administrative Support				1.11													1.11
Library				0.12													0.12
Computer Operations				0.95													0.95
II. Coordination	0.1	0.22	0	0	0.1	0	0	0.25	0	0	0	0	0	0	0	0	0.67
National Coordination	0.05	0.2			0.05			0.25									0.55
International Coordination	0.05	0.02			0.05			0									0.12
III. Nuclear Physics Databases	0	0.51	0	1.15	0	0	0	0.55	0	0	0	0	0	0	0	0	2.21
Nuclear Science References, NSR		0.2		0.4													0.6
Exper. Nucl. Structure Data, XUNDL		0.08	0														0.08
Eval. Nucl. Structure Data, ENSDF		0.08	0														0.08
Numerical Nuclear Data, NuDat				0.2													0.2
Experimental Reaction Data, CSISRS		0.09															0.09
Evaluated Nuclear Data File, ENDF		0.05															0.05
Database Software Maintenance																	0
Future Database System Develop.		0.01						0.55	0								0.56
IV. Information Dissemination	0	0.15	0	0.92	0	0	0	0	0.1	0	0	0.1	0	0	0	0	1.27
Nuclear Data Sheets		0.15		0													0.15
Customer Services				0													0
Web Maintenance & Development				0.92					0.1			0.1					1.12
V. Nuclear Structure Physics	0.85	2.86	1.03	0	0	0	0	1.45	0	0	1	1	0	1	1.7	0.03	10.92
NSR Abstract Preparation		0.2	0.1	0.3											0	0	0.6
Compilation of Exper. Structure Data		0.1									0.1				0.2	0	0.4
Eval. of Masses & Nuclides for ENSDF	0.4	1.77	0					0.8			0.6	1		1	1.4	0.03	7
Ground & Metastable State Properties	0.25	0.1															0.35
Radioactive Decay Data Evaluation	0.1							0.5									0.6
Thermal Capture Gamma Data Eval.								0									0
Nuclear Structure Data Measurement		0.69	0.63					0.15							0.1		1.57
ENSDF Evaluation Support Codes											0.25						0.25
VI. Nuclear Reaction Physics	0.05	0.69	0.2	0	0.85	0.6	0.2	0.13	0	0.13	0	0.1	0.2	0	0	0	3.145
Experimental Data Compilation		0.3	0.2														0.5
ENDF Manuals and Documentation		0.01															0.01
ENDF Evaluations		0.17			0.15					0.05							0.37
Nuclear Reaction Standards			0														0
Nuclear Model Development					0.3	0.1				0.08							0.48
Nucl. Reaction Data Measurements		0			0.4	0.5	0.2	0.13									1.225
Astrophysics Nuclear Data Needs	0.05				0							0.1	0.2				0.35
Covariances development																	0
Reactor anti-neutrino & decay heat calc.		0.21															0.21
Verification and Validation		0															0
DOE-SC Nucl. Data Funded Staff	1	4.48	1.23	4.25	0.95	0.6	0.2	2.38	0.1	0.13	1	1.2	0.2	1	1.75	0.03	20.495
Staff Supported by Other Funds	0	5.19	3.77	1.75	4.05	1.4	0.8	3.62	2.9	0.87	0	0.8	0.8	0	0.25	0.97	27.17
TOTAL STAFF	1	10	5	6	5	2	1	6	3	1	1	2	1	1	2	1	48

USNDP FTE Plots FY 2024

The plots below give the FTE distribution for Scientific Permanent, Scientific Temporary and Tech/Admin FTEs, in pie charts according to activity.






Distribution of the 4.25 Tech/Admin FTEs
Secretarial/Administrative
Library
Computer Operations
Databases
Nuclear Data Sheets
Customer Service
Web
Nuclear Structure
Nuclear Reactions

Detailed Status of the Work Plan – Fiscal Year 2024 Report

Each task area in this section is summarized with a status table listing individual tasks and their completion status. Below we present a sample task area table with the meaning of each status indicator.

XNL Planned Activities	Status	Issues/Path Forward
This is the name of the first activity.		This task is on schedule/going well/etc. It is not required to mention anything in the Issues/Path Forward box.
This is the name of the second activity.		This task is complete. Again, it is not required to discuss it.
This is the name of the third activity.		This task is behind schedule. The Issues/Path Forward field will explain/elaborate. There may be an issue HQ can help with.
This is the name of the fourth activity.		A milestone was missed. The Issues/Path Forward field will explain/elaborate. There may be an issue HQ can help with.

I. NNDC Facility Operation

A. Management

This task includes planning, budgeting, personnel, interaction with BNL management, and interaction with funding authorities.

B. Library

NNDC maintains an archival collection of low- and intermediate-energy nuclear physics publications. This library supports the NNDC compilation activities, the U.S. nuclear reaction and nuclear structure data evaluation, and international nuclear structure evaluation effort.

C. Computer Operation

The NNDC operates several Linux servers to support compilation, evaluation, database maintenance, and information dissemination functions. In addition, each staff member has a desktop computer that supports an interface to these Linux servers and supports administrative functions, such as word processing and email.

BNL Planned Activities	Status	Issues/Path Forward
In collaboration with ITD, ensure continuous availability of mission-critical Web services through full compliance of NNDC's computers with DOE cyber security requirements.		
Provide technical computer support to NNDC staff, visitors, and external collaborators to enable them to effectively and securely use		

NNDC computing resources as well as procure computer hardware, software and support services to meet NNDC's computing requirements.		
Manage the high performance NNDC/NE cluster.		
Upgrade GitLab server software to provide more powerful and advanced functionalities in the NNDC collaboration services.		
Manage the NNDC Gitlab instance to enable collaboration on various nuclear data computational projects		
Install and configure the new NNDC web/database servers		
Maintain the NNDC Web Services availability on the 99% and higher level.		
Strictly follow all BNL and DOE cybersecurity rules and regulations during the Web application design, development and implementation. Address issues that arise during BNL scans.		

II. Coordination

A. National Coordination

National coordination is required for activities under the USNDP as well as Cross Section Evaluation Working Group (CSEWG). This is mostly performed by the NNDC, with contributions from other laboratories (USNDP Working Groups and Task Forces as well as CSEWG Committees).

BNL Planned Activities	Status	Issues/Path Forward
Prepare and organize USNDP budget briefing.		
Prepare USNDP reports and work plans.		
Organize and chair CSEWG meeting at BNL.		
Organize and chair USNDP meeting at BNL.		
Edit and publish summary reports and proceedings of the CSEWG and USNDP meetings.		

Maintain CSEWG, USNDP and NDWG websites.		
Organize mini-CSEWG and/or Hackathon meetings in the summer if needed.		
Host and help organize NDAC meeting.		

LANL Planned Activities	Status	Issues/Path Forward
Organize and chair CSEWG Fission Product Yield Subcommittee meeting at BNL.		
Organize and chair CSEWG Covariance Committee meeting at BNL.		
Organize and chair Nuclear Reaction Working Group.		

LBNL Planned Activities	Status	Issues/Path Forward
Help organize WANDA meeting.		
Help organize the Berkeley Atlas co-ordination meetings.		

ORNL Planned Activities	Status	Issues/Path Forward
Coordinate and outreach USNDP Nuclear Astrophysics activities.		This task to end with retirement of Dr. M. Smith this FY.

TUNL Planned Activities	Status	Issues/Path Forward
Organize and chair USNDP Nuclear Structure Committee.		Coordinated Nuclear Structure sessions at the USNDP meeting and co-chaired Nuclear data sessions at the nuclear physics Low-Energy Community Meeting.

B. International Coordination

ANL Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		

BNL Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		

Contribute to NEA WPEC annual meeting.		
Contribute to IAEA CRP and technical meetings.		
Continue to Contribute to training/mentoring of new ENSDF evaluators through collaborative work.		

LANL Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		
Contribute to NEA WPEC annual meeting.		

LBNL Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities including level density and gamma-ray strength function CRPs and thermal capture and gamma emission CM.		

MSU Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		

TAMU Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		

TUNL Planned Activities	Status	Issues/Path Forward
Contribute to IAEA-sponsored nuclear data activities.		We participated in the IAEA NSDD meeting

III. Nuclear Physics Databases

A. Nuclear Science References (NSR)

The NNDC is responsible for NSR, the bibliographic database for nuclear physics research. This task includes quality control, file update and maintenance, and file distribution to collaborators. Updates are performed on a continuing basis. The preparation of NSR entries is given under Nuclear Structure Physics.

BNL Planned Activities	Status	Issues/Path Forward
Distribute database to collaborators.		
Perform database updates and maintenance.		
Continue joint project with the NRDC network to transfer missing nuclear reaction references to NSR.		
Study in depth the possibilities of using AI and ML techniques in NSR, in collaboration with LBNL.		Task ended. New efforts using Large Language Models will begin in FY25.

LBNL Planned Activities	Status	Issues/Path Forward
Study in depth the possibilities of using AI and ML techniques in NSR, in collaboration with BNL.		
Implement NLP techniques for auto-generation of NSR entries for comparison against human-generated data.		Starting to ramp this work down.

B. Experimental Nuclear Structure Data (XUNDL)

The NNDC is responsible for maintaining and providing access to the XUNDL database. This database contains compilations (in ENSDF format) of recently published or completed level-structure data for high-spin and low-spin physics. The NNDC coordinates this work and updates the database as new/revised data sets are received from collaborators.

BNL Planned Activities	Status	Issues/Path Forward
Perform weekly updates of the database using input received from compilers.		
Archive and distribute database yearly.		

C. Evaluated Nuclear Structure Data File (ENSDF)

The NNDC is responsible for ENSDF, a database of evaluated experimental nuclear structure and decay data. The NNDC is responsible for the format and content checking, preparation of the manuscript, and quality control (review) of evaluations submitted for inclusion. The NNDC maintains the database, which includes database updates and distribution to collaborators. Corrections are implemented on a continuous basis.

BNL Planned Activities	Status	Issues/Path Forward
Maintain ENSDF database, includes continuous updating.		
Process evaluations received from ENSDF evaluators.		
Archive and distribute ENSDF database on a monthly basis.		

Proceed with the ENSDF modernization project.		

D. Numerical Nuclear Data (NuDat)

The NNDC is responsible for NuDat, which consists of a database and a suite of codes that access it, allowing web users to search for level and γ-ray properties extracted from ENSDF, ground and metastable state properties (Wallet Cards), and atomic and nuclear radiations derived from ENSDF. Additionally, NuDat contains an interactive Chart of Nuclides and interactive level schemes.

BNL Planned Activities	Status	Issues/Path Forward
Update NuDat database as necessary.		

E. Experimental Reaction Data File (EXFOR)

The NNDC is responsible for maintaining the EXFOR database at BNL. This database contains experimental nuclear reaction data for incident energies below 1 GeV, including neutron-induced reactions and reactions with incident-charged particles of mass A ≤ 12. Many groups worldwide compile experimental data and send it to the central database in Vienna in the EXFOR format. Then, each center is responsible to update its own database. The effort described here includes quality control, file update, and data transfer activities. The NNDC database is updated as compilations are exchanged and checked from the compiling centers. The compilation activity is given under Nuclear Reaction Physics.

BNL Planned Activities	Status	Issues/Path Forward
Update EXFOR database with compilations from cooperating centers (500 entries expected). The NNDC compilation work can be found under Nuclear Reaction Physics, Section V of the present document.		
Contribute to WPEC Subgroup 50 on creating a critically reviewed version of EXFOR.		WPEC Subgroup 50 ended in FY24. The work will continue in the newly approved Subgroup 54, chaired by BNL.

F. Evaluated Nuclear Data File (ENDF)

The NNDC is responsible for ENDF, a database of evaluated nuclear data required for many nuclear applications. The work is organized under the CSEWG, coordinated by the NNDC. The ENDF file contains complete descriptions of nuclear reactions of neutrons with many nuclides and elements for energies up to 20 MeV and radiations from radioactive decay. A number of evaluations for energies up to 150 MeV and for incident-charged particles and photons are also included. The data are stored in the ENDF format developed at NNDC in the 1960s and adopted as an international standard. In addition to the U.S. library, ENDF/B, the database contains evaluated data libraries from the European Union, Japan, Russia, and China. This activity includes the processing and quality control of the U.S. ENDF/B library, the distribution of this database in the U.S. and the exchange of libraries internationally. New evaluations for the next release of the library, following ENDF/B-VIII.0, are assembled, tested and made available to users through NNDC's Web servers and GitLab collaboration server at git.nndc.bnl.gov.

BNL Planned Activities	Status	Issues/Path Forward
Maintain and improve Sigma database and web interface for users without specialized knowledge of ENDF-6 format. (See also information dissemination, Section IV.)		The legacy SIGMA system is no longer maintainable. BNL is exploring rewriting the system from scratch using modern software practices and new data formats.
Maintain and extend ADVANCE, the ENDF continuous integration system that continually checks for modification to the ENDF database then runs all available tests on the changed data files.		

IV. Information Dissemination

The goal of the dissemination activities of the USNDP is to provide scientists and engineers with nuclear data from the USNDP-maintained nuclear databases in a variety of user-friendly formats and media.

A. Nuclear Data Sheets

The USNDP provides some paper publications as well as electronic access to the nuclear physics databases that it maintains. This includes the Nuclear Data Sheets journal published by Elsevier and various versions of the Nuclear Wallet Cards.

BNL Planned Activities	Status	Issues/Path Forward
Prepare issues of Nuclear Data Sheets for publication.		
Publish a new version of the Nuclear Wallet Cards.		The book was published in October 2023. An Android phone application was last updated in July 2024. An iPhone version is in preparation.
Publish a new version of the Handbook of Radioactive Nuclei.		The book was published in October 2023.

MSU Planned Activities	Status	Issues/Path Forward
Continue development of software for Nuclear Data Sheets publication.		

B. Customer Services

This task accounts for the non-electronic services which the USNDP renders to customers. At the scientific staff level, this means direct assistance to users needing advice from nuclear data experts or advice on solving complex queries via electronic access to the database. The NNDC staff allocation at the support level is for maintaining a "help desk" as well as for administrative/clerical support of its customer services.

BNL Planned Activities	Status	Issues/Path Forward

Provide technical support to nuclear data end-users as necessary.		

C. Web Site Maintenance

The NNDC provides electronic access to the nuclear physics databases that it maintains on behalf of the USNDP as well as access to other nuclear physics information through its website. Other USNDP members also offer nuclear physics information through their websites. These services require resources to maintain currency and improve performance.

BNL Planned Activities	Status	Issues/Path Forward
Solicit user suggestions on enhancements to the ENSDF, NSR, NuDat, and Sigma web interfaces and be responsive to those needs. Expand search and plotting capabilities for ENSDF data.		
Begin developing new web interfaces for ENDF and EXFOR databases.		This work has not yet begun and will likely be rolled into the SIGMA modernization project.
Maintain currency of the CSEWG, USNDP and the NNDC websites, proactively respond to users' requests.		
Make progress with modernization of the website, enhancing capabilities and follow industry best practices.		
Continue development of mobile applications targeting highly used databases.		

ORNL Planned Activities	Status	Issues/Path Forward
Updating online nuclear astrophysics data information.		Path forward on this activity under discussion with ORNL management since retirement of Dr. M. Smith.
Incorporation of new mass compilations and new rate libraries into online collections.		Progress on this activity halted with the passing of Dr. B. Singh.

TUNL Planned Activities	Status	Issues/Path Forward
Provide access to present and past evaluations of Energy Levels of Light Nuclei for A=3-20 nuclides, including associated figures and energy-level diagrams and tables.		We continue to provide archives of evaluations produced by Fay Ajzenberg-Selove and TUNL.
Provide access to compiled and evaluated data on light nuclei related to p-, alpha- and n-capture reactions, and ground-state decays.		This task was carried out by Grace Sheu; with the hire of Dr. K. Setoodehnia we have placed more emphasis on training and evaluation tasks. We do plan to revisit and update this activity.

Provide access for TUNL dissertations collection.		We continue to post links to recent dissertations produced by students graduating from TUNL consortium institutions.

LBNL Planned Activities	Status	Issues/Path Forward
Continued maintenance of the LBNL/UCB Nuclear Data Group Website (https://nucleardata.berkeley.edu/), which attracted over 5,200 unique visitors in FY23. This website hosts information and outreach pages for the various projects carried out by the Nuclear Data Group, as well as points of contact for each project. It also hosts copies of past graduate student theses from UC Berkeley, a public codebase for tools and code develped in the group, and the WANDA workshop series homepage. This website also hosts community request databases, for identifying needs in nuclear stucture data (https://nucleardata.berkeley.edu/nsei/index.html), as well as reaction data for isotope production (https://nucleardata.berkeley.edu/ipndi/), which can used to guide funding priorities.		Starting site mirroring @ LBNL/NSD

V. Nuclear Structure Physics

A. NSR Abstract Preparation

The literature search and preparation of KEYWORD abstracts for publications included in NSR require scientific expertise. BNL continues to have the overall responsibility for this database. Similar contributions from other external collaborators are expected. These will be checked and edited by BNL as necessary before being added to the database.

BNL Planned Activities	Status	Issues/Path Forward
Prepare entries for new references and keyword abstracts for 2/3 of them. Provide coverage for 80 major journals, including complete coverage of Physical Review C and Nuclear Physics A.		

B. Compilation of Experimental Nuclear Structure Data

This activity involves compilation of recently published or completed experimental nuclear structure data for inclusion in XUNDL. The compilation is managed by the NNDC.

ANL Planned Activities	Status	Issues/Path Forward
Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database. Interact with the authors for requesting additional experimental data or for further clarification of the published results.		No new compilation requests were made by the XUNDL coordinator.

BNL Planned Activities	Status	Issues/Path Forward
Compile new B(E2) experimental data. Continue work on a B(E2) evaluation project.		
Compile new double-beta decay experimental data. Start working on a data project with Kiev Institute for Nuclear Research.		Compilation published in January 2025 issue of Atomic Data and Nuclear Data Tables.
Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database. Interact with the authors for requesting additional experimental data or for further clarification of the published results.		
Review compiled datasets submitted by other data centers prior to inclusion in the XUNDL database. Work with PRC and EPJA to check and compile data prior to publication.		

LBNL Planned Activities	Status	Issues/Path Forward
As part of our work on the Berkeley Evaluated Alpha proton Radioactivity (BEApR) database, we are compiling all experimental structure data relevant to the topic into the database.		Continue with completion in FY25-26. After that we will switch to maintenance.

MSU Planned Activities	Status	Issues/Path Forward
Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database. Interact with the authors for requesting additional experimental data or for further clarification of the published results.		
Work with PRC and EPJA to check and compile data prior to publication.		

TUNL Planned Activities	Status	Issues/Path Forward
Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database. Interact with the authors for requesting additional experimental data or for further clarification of the published results.		We compiled 65 datasets from 53 articles.

C. A-Chains and Nuclides Evaluations for ENSDF

USNDP evaluates nuclear structure and decay data for inclusion in the ENSDF database. This effort includes the critical analysis of all available experimental nuclear structure and radioactive decay data for a nuclide or a group of related nuclei to deduce recommended values from the measured data and prepare a file in ENSDF format that is the basis for publications in Nuclear Data Sheets and is used to update the contents of the USNDP nuclear structure and decay database, ENSDF.

ANL Planned Activities	Status	Issues/Path Forward
Evaluate at least one mass chain from the ANL region of responsibility.		
Review mass chain evaluations, as requested.		

BNL Planned Activities	Status	Issues/Path Forward
Evaluate at least four mass chains or their equivalent nuclides.		
Review at least four mass chains or their equivalent nuclides.		
Update ENSDF for the identification of new nuclides and for the first publication on the findings of the excited states of nuclides.		
Edit all evaluations submitted for publication, including checking their format and physics content.		
Continue mentoring new ENSDF evaluators.		

LBNL Planned Activities	Status	Issues/Path Forward
Evaluate the equivalent of at least two mass chains (~24 nuclides), including a minimum of one from the A=21-30 region. Emphasis will be placed on evaluating data of current interest to the nuclear structure and nuclear application communities.		Mass chain A = 169 has been completed. Dr. Voyles was busy with other projects and was unable to allocate time for the evaluation.
Review mass-chain evaluations, as requested.		

M.S. Basunia training new evaluator (A.S. Voyles) as part of the A = 169 mass chain evaluation.		Mass chain A = 169 has been completed. Dr. Voyles was busy with other projects and was unable to allocate time for the evaluation.

MSU Planned Activities	Status	Issues/Path Forward
Evaluate the equivalent of at least two mass chains.		
Review one mass-chain evaluation.		

ORNL Planned Activities	Status	Issues/Path Forward
Evaluate the equivalent of one mass chain.		
Review mass-chain evaluations, as requested.		

TAMU Planned Activities	Status	Issues/Path Forward
At least one mass chain, or their equivalent nuclides, will be evaluated.		
Review mass-chain evaluations, as requested.		

TUNL Planned Activities	Status	Issues/Path Forward
Evaluate about one A-chains per year for publication in Nuclear Data Sheets and inclusion in the ENSDF database. An objective is to produce two A-chain evaluations per year.		Our evaluation of A=13 nuclides was resubmitted (and accepted for future publication). The evaluation of A=14 continues. A sizeable effort went into an evaluation of ^{18}Ne (122 pages), which was submitted for ENSDF in July; a similar effort is going into an evaluation of ^{19}Ne (200+ pages).
Evaluate and update ENSDF for A=2-20 near drip-line nuclides, especially for first observations or when ENSDF has no previous dataset.		We provided updates on ^{4}n (tetraneutron), ^{7}H, ^{9}N and ^{16}Be.
Update various reaction datasets in ENSDF, such as for beta-decay and beta-delayed particle emission.		We foresee an end to this task since our emphasis now is on nuclide and A-chain evaluations.

D. Ground and Excited State Properties

ANL Planned Activities	Status	Issues/Path Forward
Compile and evaluate atomic masses and complementary nuclear structure data for the Atomic Mass Evaluation and the NUBASE evaluation of nuclear properties.		

E. Non-ENSDF Decay Data Evaluations

ANL Planned Activities	Status	Issues/Path Forward
Contribute to the IAEA-led project on "Evaluated Decay Data Library for Monitoring Applications."		

LBNL Planned Activities	Status	Issues/Path Forward
Work with researchers at Pacific Northwest National Laboratory on the development of a numerical database with complete Gamma-ray-X ray coincidence data in a joint effort with the Defense Threat Reduction Agency. The database will be benchmarked against existing decay data from ENSDF as well as recently published datasets not yet included in ENSDF. These efforts will be coordinated with the ENSDF modernization initiative led by BNL.		
The Berkeley Evaluated Alpha proton Radioactivity (BEApR) database is an online global evaluation/database of all published information on heavy charged particle emitters. It is updated monthly and contains all data (T1/2, branch ratios, E, Jp, etc.) for all nuclei that decay by beta-delayed or direct proton, alpha, cluster or fission, organized by Tz. We have compiled and evaluated data from Tz= -4 to Tz = +18, with the rest of the database (up to Tz=30) expected to be finished in early 2024. We have also been developing a a JSON format for the data in addition to a software package implemented in Python for handling and manipulation of the data.		The Berkeley Evaluated Alpha proton Radioactivity (BEApR) database is an online global evaluation/database of all published information on heavy charged particle emitters. It is updated monthly and contains all data (T1/2, branch ratios, E, Jp, etc.) for all nuclei that decay by beta-delayed or direct proton, alpha, cluster or fission, organized by Tz. We have compiled and evaluated data from Tz= -4 to **Tz = +26,** with the rest of the database (up to Tz=30) expected to be finished in early 2024. We have also been developing a a JSON format for the data in addition to a software package implemented in Python for handling and manipulation of the data.

MSU Planned Activities	Status	Issues/Path Forward
Contribute to the IAEA-led project on "Evaluated Decay Data Library for Monitoring Applications."		

F. Neutron-induced g-Ray Data Evaluation

LBNL Planned Activities	Status	Issues/Path Forward
Continue updating the Inelastic Scattering of Reactor Fast Neutrons Database (e.g., the "Baghdad Atlas") with modern ENSDF data, as a		

validation database for (n,n'gamma) as well as with additional sources of energy differential (n,n'gamma) data from GELINA at Geel, neutronELBE at HZDR, and the GENESIS array at LBNL. Extract information from ENDF needed to produce flux-weighted partial gamma-ray cross sections and comparing the result to values in the Atlas.		
Start benchmarking reaction modeling codes, including Talys and EMPIRE. This work will be performed in collaboration with researchers from the IAEA and Naval Nuclear Laboratory.		Discontinued
Explore the role of quasi-continuum contributions through collaboration with researchers from LLNL and the University of Oslo.		Being pursued under separate (including NDIAWG) funding. Work being pursued in collaboration with scientists from the IAEA, Ohio University, Charles University (Prague) and others.
Maintain and develop pyEGAF for projects related to improving neutron-capture gamma-ray data libraries, e.g., GRIN-related efforts		

G. Nuclear Structure Data Measurements

ANL Planned Activities	Status	Issues/Path Forward
Contribute to nuclear physics research activities at ANL, MSU, and other nuclear physics user facilities with the main emphasis on decay studies of neutron-rich nuclei, spectroscopy of heavy actinide nuclei, and nuclei far from the line of stability.		

BNL Planned Activities	Status	Issues/Path Forward
Precisely determine decay schemes of relevant medical isotopes using state-of-the-art gamma-ray spectroscopy.		
Contribute to beta-decay measurements at facilities, such as Argonne's CARIBU and MSU's FRIB, with an emphasis on nuclei relevant to decay heat, antineutrino spectra, and delayed nu-bar.		
Setup new gamma-alpha coincidence station.		

LBNL Planned Activities	Status	Issues/Path Forward
Perform targeted decay-data measurements to address inconsistencies in decay data using		

light-ion and neutron activation and the Fast Loading and Unloading Facility for Fission Fragment Yields (FLUFFY) combined with a local array of single-crystal and Clover HPGe detectors. Results from these experiments will be published and updates presented to the ENSDF database manager.		

MSU Planned Activities	Status	Issues/Path Forward
Contribute to gamma-ray spectroscopy and lifetime measurements with GRETINA at FRIB		

H. ENSDF Physics and Checking Codes

BNL Planned Activities	Status	Issues/Path Forward
Maintain and upgrade ENSDF checking and physics programs for format changes as required.		
Work on the development of a new editor for the ENSDF format and develop applications that apply Machine Learning techniques to the new format.		

MSU Planned Activities	Status	Issues/Path Forward
Maintain and improve the ENSDF utility and analysis codes in Java developed at MSU, such as McMaster-MSUJava-NDS, ConsistencyCheck, GLSC, Java-RULER, Excel2ENSDF, KeynumberCheck, AME-Nubase-viewer, FormatCheck, AlphaHF, RadiationReport.		
Develop new Java codes to replace the remaining legacy ENSDF codes in Fortran that lack maintenance.		
Develop new Java-NDS program and other utility and analysis Java codes to work with the new ENSDF JSON format		

LLNL Planned Activities	Status	Issues/Path Forward
Collaborate with BNL in the development of the next generation ENSDF format and develop applications that apply Machine Learning techniques to the new format.		Will continue within the awarded NDIAWG evaluator traineeship

VI. Nuclear Reaction Physics

A. Experimental Data Compilation

The NNDC, as part of a larger international cooperation, has responsibility for compiling experimental nuclear reaction data that have been produced in the U.S. and Canada.

BNL Planned Activities	Status	Issues/Path Forward
Compile experimental data for neutron, charged-particle, and photon-induced reactions from over one hundred publications.		
Explore possibilities of recovering previously unobtainable reaction data and proactively respond to users' needs.		

B. ENDF Manuals and Documentation

The NNDC is responsible for maintaining the format and procedures manual for the ENDF system as well as producing the documentation supporting the contents of the ENDF/B library.

BNL Planned Activities	Status	Issues/Path Forward
Maintain the GitLab version of the ENDF-6 formats manual current with CSEWG-endorsed format changes. Issue official release of the manual.		
Automate the generation and posting of the latest unofficial version of the ENDF-6 formats manual.		
Coordinate development of the format specification for the GNDS (the successor format to ENDF-6) with the legacy ENDF-6 format during the transition to GNDS.		

C. ENDF Evaluations

Evaluated nuclear reaction data, for applications and basic science needs, are stored in the ENDF database, which is maintained by BNL. As Chair of the CSEWG Evaluation Committee, LANL staff works with BNL to ensure quality control, particularly for new evaluations. New evaluations funded primarily from other sources are prepared for archival in the ENDF library. BNL, LANL, LLNL and ORNL provided neutron, proton, and photonuclear reaction data evaluations.

BNL Planned Activities	Status	Issues/Path Forward
Respond to user needs for evaluated nuclear reaction data.		
Collect and address users feedback related to the ENDF library.		

Complete evaluations for Zr isotopes to support new reactor fuel concepts.		Task in progress. BNL will lead a new WPEC Subgroup 53 tasked with completing Zr evaluations in collaboration with RPI, ORNL and several other institutions. Greg Siemers, an RPI Ph.D. student, visited BNL in June 2024 and was trained on EMPIRE usage.
Work with CSEWG on upgraded evaluations for future release of the ENDF/B library.		ENDF/B-VIII.1 data files were released on August 30, 2024.
Improve methodology for providing covariance data in the resonance and fast neutron region to the next release of ENDF.		
Update the Decay Data Sub-library as new data for neutron-rich nuclides become available.		
Improve methodology for generating unresolved resonance region cross section probability distributions.		
Maintain the Atlas of Neutron Resonances electronic files in preparation for a future update of the Atlas of Neutron Resonances. Continue working on the use of ML techniques to better determine resonance properties.		
Contribute to the Fission Yield evaluation CRP at the IAEA.		

LANL Planned Activities	**Status**	**Issues/Path Forward**
Upgrade the LANL ENDF evaluations for actinides as well as some other structural materials that perform well in criticality benchmarks, including new theoretical development of statistical model for deformed systems. Close collaboration with international nuclear data library activities at the IAEA and OECD/NEA.		
Provide new evaluations of the prompt and delayed neutron multiplicities for both major and minor actinides, based on the Monte Carlo technique as well as the deterministic method, which are consistent with the fission product yield evaluations.		
Improve photon production data for neutron capture and inelastic scattering, which will be used in prompt gamma-ray spectroscopy.		
Improve calculations for neutron-induced charged-particle reactions in collaboration with LENZ/LANCE, and produce evaluated files based on these data.		

LBNL Planned Activities	Status	Issues/Path Forward
Supporting ENDF via contribution to the Gamma-Rays Induced by Neutrons (GRIN) collaboration, which has a focus on the improvement of the gamma-ray data in the ENDF libraries. Extrapolation methods to higher incident neutron energies are also under development. In FY24, the development of the capture-gamma data will continue for prioritized isotopes in addition to validation work using the Baghdad Atlas based on the characterization of the neutron flux described in a corresponding reference article.		Continued under base funding in FY25.

LLNL Planned Activities	Status	Issues/Path Forward
Perform new evaluations as per LLNL customer requests and submit these as well as other LLNL-generated evaluations into ENDF.		Contributed to 239Pu evaluation. Further improvements in development.
Perform R-matrix fits for proton and alpha particles incident on selected medium-mass nuclei (4 A 50) to accurately describe low-energy resonances and make candidates for future ENDF/B-VIII evaluations.		Partially complete: 4He+3He evaluation was completed and accepted in ENDF/B-VIII.1. However, due to personnel changes, this activity will not be continued.
Improve transitions from R-matrix resonance regions to statistical models at higher energies, to give better predictions of gamma production.		Due to Ian Thompson's retirement, this activity cannot be completed
Add candidate exit distributions of charged-particle productions (for ENDF/B-VIII.1)		

D. Nuclear Reaction Standards

Nearly all neutron cross section measurements are made relative to a neutron cross section standard, such as the hydrogen elastic cross section. The primary objective of this task is to ensure accurate and current values for standard cross sections and related quantities. In preparation for new evaluations of the standards, we are improving the standards database and procedures under the auspices of the IAEA data development project "Maintenance of the Neutron Cross Section Standards." Historically, the standards evaluation activity has included data from other than the cross section standards, i.e., the thermal constants and the 252Cf spontaneous fission neutron spectrum. Recently, the scope has been broadened, largely through the data development project, to include inelastic scattering cross section reference standards; adding an additional standards energy range for the Au(n,γ) cross section; and proposing updates for the evaluations of the 252Cf spontaneous fission neutron spectrum and the 235U thermal neutron-induced fission neutron spectrum.

BNL Planned Activities	Status	Issues/Path Forward
Continue work on standards evaluations through involvement in the IAEA data development project "maintenance of the neutron cross section standards. Checking the literature and other sources for possible measurements related to standards.		BNL froze all contracts with unincorporated contractors, including that of Allan Carlson. This effectively halted Standards work at BNL.
Continue involvement with nuclear data groups as a) A member of the program committee of the International Symposium on Reactor Dosimetry's 18th International Symposium on Reactor Dosimetry (ISRD-18). Due to concerns about the virus, the ISRD- 17 meeting was held May 21-26, 2023 (instead of 2020) in Lausanne Switzerland. Program Committee meetings were attended in 2023. The agenda of those meetings included updates on the meeting in May, issues concerning future symposium papers, the location of the ISRD-18 meeting (in the USA), and assignments for various positions (workshop, poster session and technical chairs) for the 2023 meeting. There are still lingering concerns about meetings due to Covid-19. b) A member of the International Advisory Board for the 5th International Workshop on Nuclear Data Covariances (CW2020), which was finally held virtually in 2022 as CW2022. A paper on our work on spectrum averaged cross sections (SACs) and ratios of SACs was presented. The use of an improved program replacing GMA based on Python was required for this work since GMA does not have the capability to handle ratios of SACs. This work has led to changes in some standards.		BNL froze all contracts with unincorporated contractors, including that of Allan Carlson. This effectively halted Standards work at BNL.
Work will continue on both 6Li(n,t) and 235U(n,f) measurements at NIST with sub-thermal neutrons when conditions improve concerning the NIST reactor.		BNL froze all contracts with unincorporated contractors, including that of Allan Carlson. This effectively halted Standards work at BNL.
Finish publishing the report on the IAEA Consultants' hybrid Meeting on Neutron Data Standards Oct. 9-13, 2023. All earlier standards reports have now been published. Work closely with Professor Zhang of the Peking University in Beijing, China on improvements to new measurements at the China Spallation Neutron Source (CSNS). The CSNS is a major facility for making neutron data measurements. Plans are being made for virtual standards meetings with		BNL froze all contracts with unincorporated contractors, including that of Allan Carlson. This effectively halted Standards work at BNL.

a limited attendance followed by the next standards meeting where more information may be available on when a new standards evaluation can occur.		

LBNL Planned Activities	Status	Issues/Path Forward
Working with IAEA "Charged-particle cross section database for medical radioisotope production" CRP group for selection of new reaction monitor standards for upcoming database update.		Continuing
Planning to perform an evaluation of the 93Nb(p,4n)90Mo monitor reaction, based on prior work performed by the LBNL/UCB Nuclear Data Group, along with LANL and BNL collaborators.		Continuing under Isotope Program funding

LLNL Planned Activities	Status	Issues/Path Forward
Verify and validate R-matrix fits for 6Li(n,t) and 10B(n,a) standards reactions		
Verify and extend GMA data fitting methods		Due to Ian Thompson's retirement, this activity cannot be completed

E. Nuclear Model Development

This task covers activities, such as the development and validation of nuclear reaction models, used for prediction of nuclear reaction cross sections. The two major codes are CoH3 (LANL) and EMPIRE (BNL). Measurements made by ANL, LANL and LBNL, along with other measurements made with DOE low-energy physics funds, will play a crucial role in the validation of the models in these computer codes. LANL participates in the IAEA Coordinated Research Project RIPL that improves the accuracy and reliability of input parameters used in nuclear reaction calculations.

BNL Planned Activities	Status	Issues/Path Forward
Model (n,gamma) spectra to address a major shortcoming in the ENDF library as noted in WANDA 2020.		This project continues with NA-22 funding.

LANL Planned Activities	Status	Issues/Path Forward
Continue to develop a microscopic description of the fission process based on penetrability calculations through arbitrary fission barrier		

shapes. Extend the technique to include multi-chance fission at higher energies. Implement the theory into the Hauser-Feshbach code to facilitate actinide evaluations.		
Continue to develop a coupled-channels Hauser-Feshbach method for better prediction of neutron- induced reactions on deformed nuclei, with particular emphasis on fission, capture, and inelastic scattering channels.		
Continue to develop the Hauser-Feshbach fission fragment decay code for evaluating major actinides, which has a unique capability to produce prompt fission neutron and gamma-ray spectra.		
Continue to develop a semi-microscopic model for nuclear structure, which will be incorporated into the reaction calculations.		

LBNL Planned Activities	Status	Issues/Path Forward
Continue benchmarking and improving reaction modeling codes, including Talys and EMPIRE. This work will be performed in collaboration with researchers from the IAEA, LANL, and Naval Nuclear Laboratory.		Continuing under both USNDP and external funding.

F. Nuclear Reaction Data Measurements

LANL Planned Activities	Status	Issues/Path Forward
Finalize double-differential cross sections of 54Fe(n,z) and 56Fe(n,z) in respect to incoming neutron energies and outgoing particles angles for the neutron energy range of 0.5 - 20 MeV.		
Finalize double-differential cross sections of 58Ni(n,z) and 60Ni(n,z) in respect to incoming neutron energies and outgoing particles angles for the neutron energy range of 0.5 - 20 MeV.		
Finalize cross sections of 40K(n,p) and 40K(n,a) reactions for the neutron energy range of 0.1 - 6.0 MeV.		
Perform double-differential cross sections of Zn isotopes in respect to incoming neutron energies and outgoing particles angles for the neutron energy range of 0.5 - 20 MeV.		

Improve the precision measurements on angular distributions of the 16O(n,α) reaction at LANSCE.		

LBNL Planned Activities	Status	Issues/Path Forward
Study n,n'gamma reactions using the Gamma Energy Neutron Energy Spectrometer for Inelastic Scattering (GENESIS) and nEXUS.		Partially externally funded (NA-22, NA-113)
LBNL will work with external collaborators to study production rates of 209Bi(d,2n)209Po for RTG power sources.		Discontinued as USNDP activity, proceeding with corporate sponsorship
LBNL will continue collecting (p,x) reaction data from threshold to 200 MeV in collaboration with LANL and BNL, for production of isotopes of interest to the DOE Isotope Program.		Partially externally funded (DOE-Isotope Program)
LBNL will continue exploring the use of intense neutron sources from deuteron breakup to measure (n,x) cross sections of interest for isotope production.		Partially externally funded
LBNL will perform measurements of Mo(d,xn) cross section measurements for the production of 95mTc and 97mTc, as tracers for diagostics for NIF radiochemical applications		Discontinued as USNDP activity, proceeding with corporate sponsorship
LBNL will work with partners at the National Ignition Facility at LLNL in the Starfire collaboration to identify nuclear data needs related to materials damage and gas production cross section measurements relevant to fusion power systems. This includes identifying speakers for the WANDA meeting and creating prioritized lists of measurements, modeling and processing activities. It will also include carrying out one or more irradiation of high-priority materials for fusion power systems using energetic neutrons from the thick target deuteron breakup neutron source at the 88-Inch cyclotron.		External funding and base support
LBNL will engage with partners in NASA and the Missile Defence Agency to identify and carry out one or more targeted stopping power measurements using heavy-ion beams at the 88-Inch cyclotron. This work will be carried out by members of the 88-Inch cyclotron operations staff as part of their graduate studies in the UC Berkeley Nuclear Engineering Department.		Continuing. First experiments performed in February 2025. successful

As a partner in the NDIAWG FOA-funded Berkeley Atlas project LBNL will perform targeted (n,n'gamma) cross section measurements using a Deuterium-Tritium Associated Particle Imaging (DT-API) at LBNL and partner with the Nuclear Technology Innovation Laboratory in the UC Berkeley Nuclear Engineering Department to and install and operate a new system DT-API system in Etcheverry Hall on the UC Berkeley campus.		Partially externally funded (NDIAWG and UC Berkeley (Nuclear Technology Innovation Laboratory)
In partnership with NA-241 the LBNL group will engage in targeted high-priority microcalorimeter measurements and decay data evaluations relevant to nuclear safeguards. LBNL will also produce radionuclides needed to calibrate microcalorimeters used to produce the required decay data.		Continuing jointly with external funding.
Leading (p,x) measurement campaign to improve nuclear reaction models in collaboration with National Institute for Nuclear Physics (INFN-Legnaro, Italy) and the University of Oslo (Oslo, Norway).		

G. Astrophysics Nuclear Data Needs

The objective of this activity is to support the nuclear data needs of the increasingly sophisticated simulations of astrophysical phenomena. The Astrophysics Task Force of the USNDP, presently chaired by ORNL, serves to improve communication and coordination of nuclear data evaluation activities relevant for studies in astrophysics.

ANL Planned Activities	Status	Issues/Path Forward
Provide recently compiled and evaluated nuclear data of nuclear physics properties for astrophysics modeling at FRIB		

BNL Planned Activities	Status	Issues/Path Forward
Work on neutron capture and fission integral values and their uncertainties in the energy region of interest for nuclear astrophysics.		MACS, reaction rates, and r-process abundances were calculated using ENDF/B-VIII.1, JEFF-3.3, JENDL-5.0, CENDL-3.2, BROND-3.1 libraries. Results are accepted for publication in Atomic Data and Nuclear Data Tables.
Evaluate nuclear astrophysics potential of EXFOR library.		

LANL Planned Activities	Status	Issues/Path Forward

Continue improvement of neutron capture, beta-delayed neutron and fission modellings for s- and r-process hydro-dynamics simulations.		
Develop network calculations for nucleosynthesis of heavy elements by implementing newly updated experimental reaction rates in relevant astrophysical scenarios.		

LBNL Planned Activities	Status	Issues/Path Forward
LBNL will lead and co-lead experimental efforts to measure relevant data in the quasicontinuum in particular related to i-process nucleosynthesis to constrain model uncertainties. It will also co-lead an analytical effort to, for the first time, explore photon strength function data into the lowest energy regime which remains the unexplored region but may have significant impact on i- and r-process nucleosynthesis.		

ORNL Planned Activities	Status	Issues/Path Forward
Continue assessments of capture reactions on p-rich unstable nuclides that are important for novae and X-ray bursts. The nuclei to be studied are those planned for measurements at radioactive beam facilities.		Path forward under discussion with ORNL management as a result of the recent retirement of Dr. M. Smith.

H. Covariances Development

LBNL Planned Activities	Status	Issues/Path Forward
Continue to develop an experimentally driven fission covariance database		

I. Reactor Antineutrino Spectra and Decay Heat Calculations

BNL Planned Activities	Status	Issues/Path Forward
Improve our methods and databases to calculate anti-neutrino spectra for major actinides.		Presentations made at the AAP 2023 meeting in York, UK. Article detailing isomeric ratios effect submitted for publication.

Perform decay-heat calculations in collaboration with experimental groups.		
Contribute to relevant experiments.		

J. Verification and Validation

Quality Assurance (QA) of a nuclear data library requires that all files are checked for integral consistency and conformance with the adopted format. This part of the QA is called verification and is one of the fundamental functions of the NNDC. Furthermore, checking performance of the library against the integral experiments, known as validation, is also an important step to ensure the usefulness of the library for the end-users. The most extensive validation is performed by LANL and other CSEWG contributors funded with non-DOE-SC sources. The USNDP supports the ultimate validation effort carried out at BNL.

BNL Planned Activities	Status	Issues/Path Forward
Maintain automatic, real-time verification and validation of new/modified ENDF evaluations submitted to the NNDC GitLab server.		

Appendix A – Additional Funding Sources

ANL

Nuclear Data activities at ANL are supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357. Additional support for the nuclear data work comes from the LAB 18-1903 funded proposal (DOE/SC/NP and DOE/NNSA/NA-22) and DOE/SC/NP funded proposal #0000269682 that is led by MSU (PI W. Nazarewicz).

BNL

BNL scientists are engaged in a number of non-USNDP funded nuclear data activities, most notably with the continued support of the National Criticality Safety Program (NCSP) and the Defense Nuclear Nonproliferation (NA-22) Program. Currently the NCSP partly funds the operation of the Evaluated Nuclear Data File library project, in conjunction with the USNDP. The NCSP also funds development of analytical methods for thermal neutron scattering data and unresolved resonance probability distribution generation and a neutron resonance spingroup assignment machine learning project. NA-22 funds several projects as a direct result of the Nuclear Data Interagency Working Group proposal process. These projects include measurements of decay data relevant for non-proliferation, library development to support active neutron interrogation, and data work supporting the intentional forensics mission.

The full list of non-USNDP NNDC projects is:

1. The US Nuclear Criticality Safety Program (NCSP) supports the NNDC services in maintaining NCSP data submitted to the ENDF/B library as well as data development work on evaluations of neutron cross section covariances for criticality safety applications.
2. Evaluation of energy dependent fission product yields, funded by NA-22.
3. NA-22 Intentional Forensics Venture, a project to develop a tagging system for nuclear fuel.
4. High precision decay measurements of isotopes relevant to nuclear forensics, funded by NA-22.
5. Six NDWIAG FOA-funded proposals:
    - Analyzing the impact of nuclear data on next generation reactors and developing tools to continuously assess the impact in the ENDF continuous integration system (with ORNL)
    - Developing benchmarks for validating coincidence data added to neutron capture ENDF data as part of the GRIN project (with RPI)
    - Developing benchmarks for inelastic scattering data added to ENDF during the GRIN project (with LBNL, John's Hopkins U)
    - Gamma Rays Induced by Neutrons (GRIN), performing outgoing gamma evaluations, funded by NA-22 (with LBNL, LLNL)
    - Structure Based Evaluations of Nuclear Data, using proper structure information to perform R-matrix evaluations (with LANL, LLNL)
    - AI Guided re-evaluation of the 252Cf(sf) spectrum (with LANL)

LANL

LANL nuclear data team is composed of nuclear reaction theorists and experimentalists to perform measurements at Los Alamos Neutron Science Center and other charged particle beam facilities such as University of Notre Dame, Ohio University, and Texas A&M University.

Additional supports for the nuclear data project are as follows:

1. Advanced Simulation and Computing under NNSA
2. Science Campaign support under Office of Experimental Sciences by NNSA
3. The US Nuclear Criticality Safety Program (NCSP)
4. Evaluation of gamma-ray production, funded by NA-22
5. New (alpha,n) experimental data and R-matrix assessment, funded by NA-22
6. New Cl-35 data and fast evaluation, funded by DOE-NE GAIN through TerraPower

LANL-LDRD to study fast-neutron induced reaction measurements on ^{26}Al and ^{44}Ti at LANSCE.

LBNL

Additional supports for the LBNL nuclear data project are listed below. (Funding agency and approximate FTE funding levels are included in parentheses):

1. GENESIS 2.0 measurement program (NA-22, 3 FTE, 1 PD) measuring (n,xngamma) cross sections using the Gamma Energy Neutron Energy Spectrometer for Inelastic Scattering)
2. TREND 2.0 modeling program (DOE Isotope Program, 0.2 FTE, 1 GS) Developing Machine-learning based reaction model optimization for radionuclide isotope production in collaboration with LANL and BNL.
3. Microcalorimetry Data for Nuclear Safeguards (NA-241, 0.5 FTE) Improving nuclear decay data for materials accountability and collaborating on measurements through fabrication of 169Yb calibrations sources for high resolution microcalorimeters.
4. IFE-STARFIRE (DOE Fusion Energy Sciences, 0.25 FTE) Studying neutron-induced reaction damage on final stage optical components for Inertial Confinement Fusion at the National Ignition Facility.
5. Nuclear Waste Transformation via Nuclear Plasma Interactions (Google, 0.25 FTE) Faculty support grant for exploring the use of energetic photons and electrons to transmute nuclear waste through photoexcitation using the Berkeley Lab Laser Accelerator (BELLA). First results were published in February 2025 in Physical Review Letters.
6. Decay on Demand (DARPA, 0.8 FTE). Exploring the use of BELLA to accelerate the decay of the ^{229}Th in order to produce the valuable medical radionuclide ^{225}Ac.
7. Correlated Neutron Gamma Data for Stewardship Science (NA-113, 0.4 FTE, 0.25 PD, 2 GS) Stewardship Science Academic Alliance Grant through UC Berkeley to measure (n,xn gamma) data using GENESIS.
8. Nuclear Technology Innovation Laboratory (UC Berkeley, 0.5 FTE). The UC Berkeley College of Engineering is supporting the establishment of a capability to develop new nuclear capabilities in support of research and education for fission and fusion energy systems, nonproliferation, medical isotope production, space exploration, nuclear material studies and fundamental nuclear science. The initial funding will be in place from September 2023- to August 2028.

LLNL

Livermore Laboratory has had a program for nuclear data for almost 60 years, and this has been often independent of the national ENDF library format. In that time, LLNL has made its own ENDL libraries in format designed for punched cards, and it has its own groups of evaluators leading to revisions about twice per decade. In the 70s the ENDL libraries were described by a comprehensive series of 20 descriptive volumes published under the label of UCRL-50400.

Because this original ENDL format was less flexible than the ENDF format, in the recent decade we have had some incentive to make more modern data structure, and this led us to designing, coding and translating the new Generalized Nuclear Data Structure (GNDS). This GNDS format is now maintained internationally by WPEC, and it is used internally at LLNL for all stages of the nuclear pipeline from decay models, data storage, translation, testing and processing for transport codes. It is the most comprehensive method for interchange of nuclear data and is becoming widely adopted as the preferred future standard.

The nuclear data that LLNL uses comes from a variety of sources. We examine existing libraries to determine which provides the best description of nuclear cross sections, and often use our own models for neutron reactions and decay processes. We have optimized our own Hauser-Feshbach models for neutron reactions on a wide variety of fission fragments and other nuclides of use for radiochemistry. As one of the first labs to comprehensively transport both neutrons and charged particles (isotopes of hydrogen and helium) we have a comprehensive library of low-energy charged-particle evaluations, with particular attention to exothermic reactions on targets up to lithium isotopes.

In the last 15 years the experimental groups at LLNL have been using the indirect 'surrogate' method to measure cross-sections for which direct detection is unavailable, and the results have been made into GNDS evaluations to determine the effects of the new cross-sections. We test all evaluations by comparison with the standard database of critical-assembly measurements and by comparison with the pulsed-sphere measurements once performed at LLNL. New critical assemblies are being created, measured and modeled. The national collaboration to use a Time Projection Chamber to measure actinide and standard cross-sections is being led by LLNL experimentalists. We have used both ENDL and ENDF processed libraries in transport codes for programmatic work.

The USNDP provides a small contribution to the LLNL nuclear data team to enable the sharing of in-house data products with the national community. Our GNDS work is funded outside USNDP and has provided thorough checks of the ENDF libraries submitted by various groups.

Additional supports for the LLNL nuclear data project are as follows:
1. Advanced Simulation and Computing under NNSA.
2. The US Nuclear Criticality Safety Program (NCSP).

MSU

Data activities are supported by U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Contract No. DE-SC0016948.

ORNL

The nuclear data work is partly funded by the DOE-SC Low Energy Nuclear Physics program.

TAMU

Data and experimental activities supported by U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Contract No. DE-FG02-93ER40773.

TUNL
The nuclear data work is funded by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under Contract Nos. DE-FG02-97ER41042−North Carolina State University and DE-FG02-97ER41033−Duke University.

Appendix B – USNDP Data and Code Products

Joint Products		
Evaluated Nuclear Data File (ENDF)	**POC:** David Brown (dbrown@bnl.gov) CSEWG Chair, Gustavo Nobre (gnobre@bnl.gov) ENDF Library Manager	**URL:** https://www.nndc.bnl.gov/endf/
	Description: Core nuclear reaction database containing evaluated (recommended) data from the ENDF/B-VIII.0 library. It provides data in the ENDF-6 format, covering all nuclides of practical relevance for neutrons up to 20 MeV and partly up to 150 MeV. It serves as principal input for neutronics calculations, including nuclear reactor design, national security, accelerators, criticality safety, shielding, radiation protection and detector simulation.	
Evaluated Nuclear Structure Data File (ENSDF)	**POC:** Elizabeth Ricard (mccutchan@bnl.gov)	**URL:** https://www.nndc.bnl.gov/ensdf/
	Description: Core nuclear structure and decay database containing evaluated (recommended) data for 3,171 nuclides, organized in over 17,269 individual datasets. It serves as principal source of data for nuclear structure research, nuclear spectroscopy applications, MIRD, NuDat, and publications such as Nuclear Data Sheets and Table of Isotopes.	
eXperimental Unevaluated Nuclear Data Library (XUNDL)	**POC:** Elizabeth Ricard (mccutchan@bnl.gov)	**URL:** https://www.nndc.bnl.gov/xundl/
	Description: Experimental nuclear structure and decay data, covering more than 2,500 recent nuclear structure and decay articles. The XUNDL database contains 4,212 datasets for 1,990 nuclides.	

Argonne National Laboratory		
Argonne Nuclear Data and Measurements Reports (ANL/NDM)	**POC:** Filip Kondev (kondev@anl.gov)	**URL:** https://www.anl.gov/phy/reference/argonne-nuclear-data-measurement-anlndm-reports
	Description: Contain experimental and evaluated data produced at ANL since 1978, including a) measured microscopic nuclear parameters, b) experimental techniques and facilities employed in measurements, c) the analysis, correlation and interpretation of nuclear data, d) the compilation and evaluation of nuclear data	
Atomic Mass Evaluation (AME)	**POC:** Filip Kondev (kondev@anl.gov)	**URL:** https://www.anl.gov/phy/atomic-mass-data-resources
	Description: Provides evaluated (recommended) data for the atomic masses and their derivatives for 3557 nuclides; uses NSR and NUBASE	
Evaluation of Properties of K-Isomers in Deformed Nuclei	**POC:** Filip Kondev (kondev@anl.gov)	**URL:** https://www.sciencedirect.com/science/article/pii/S0092640X15000029
	Description: Contain evaluated (recommended) data for the properties of K isomers in deformed nuclei; uses NSR, NUBASE and ENSDF	
NUBASE Evaluation of	**POC:** Filip Kondev (kondev@anl.gov)	**URL:** https://www.anl.gov/phy/atomic-mass-data-resources

Basic Nuclear Properties (NUBASE)	**Description:** Provides evaluated (recommended) data for the basic properties for 3340 nuclides in their ground state and 1938 isomers (T1/2>100 ns); uses NSR, AME and ENSDF	
Nucleus++	**POC:** Filip Kondev (kondev@anl.gov)	**URL:** https://www.anl.gov/phy/atomic-mass-data-resources
	Description: Desktop (MacOS Windows) and mobile (iOS, iPadOS Android) applications visualizing evaluated data available in the AME and NUBASE libraries	

Brookhaven National Laboratory, National Nuclear Data Center		
Atlas of Neutron Resonances	**POC:** David Brown (dbrown@bnl.gov)	**URL:** https://www.nndc.bnl.gov/atlas/
	Description: The sixth edition of the vaunted BNL-325 "Barn book", authored by Dr. Said Mughabghab and published by Elsevier in two volumes on April 17, 2006. The present sixth edition differs from previous editions in that available capture, fission, and total neutron cross sections in the keV-Mev neutron energy region were analyzed by the author with the objective of determining average neutron resonance parameters and compared to those obtained from the resolved energy regions. In addition to the extensive list of detailed individual resonance parameters for each nucleus, this contains thermal cross sections and average resonance parameters as well as a short survey of the physics of thermal and resonance neutrons with emphasis on evaluation methods.	
B(E2) Evaluation	**POC:** Boris Pritychenko (pritychenko@bnl.gov)	**URL:** https://www.nndc.bnl.gov/be2/
	Description: Recent data on electric quadrupole transition probabilities or B(E2; 0+ → 2+) values	
CapGam	**POC:** Benjamin Shu (bshu@bnl.gov)	**URL:** https://www.nndc.bnl.gov/capgam/
	Description: The energy and photon intensity with uncertainties of gamma rays as seen in thermal-neutron capture are presented in two tables, one in ascending order of gamma energy and a second organized by Z, A of the target.	
Computer Index of Nuclear (reaction) Data (CINDA)	**POC:** Boris Pritychenko (pritychenko@bnl.gov)	**URL:** https://www.nndc.bnl.gov/cinda/
	Description: Bibliographical neutron induced reaction information, including experimental, theoretical and evaluation works. It contains references to 275,000 reactions from 55,000 works.	
Double Beta Decay Data	**POC:** Boris Pritychenko (pritychenko@bnl.gov)	**URL:** https://www.nndc.bnl.gov/bbdecay/
	Description: Data on double beta (ββ) decay, data content is integrated with the Nuclear Science References (NSR) database.	
Medical Internal Radiation Dose (MIRD)	**POC:** Elizabeth Ricard (mccutchan@bnl.gov)	**URL:** https://www.nndc.bnl.gov/mird/
	Description: Evaluated nuclear decay data for over 2,100 radioactive nuclei. Data are extracted from ENSDF, processed by the program RadList, and used for medical internal radiation dose calculations.	
NuDat3	**POC:** Donnie Mason (dmason@bnl.gov)	**URL:** https://www.nndc.bnl.gov/nudat3/

	Description: Evaluated (recommended) nuclear structure and decay information for 3,175 nuclides, about 161,895 levels, 243,639 gamma-rays, etc. Obtained from ENSDF and Nuclear Wallet Cards.	
Nuclear Wallet Cards	**POC:** Elizabeth Ricard (mccutchan@bnl.gov)	**URL:** https://www.nndc.bnl.gov/nudat3/indx_sigma.jsp
	Description: Observable nuclear properties for ground- and isomer-states of all known nuclides.	
Q Value Calculator (QCalc)	**POC:** Benjamin Shu (bshu@bnl.gov)	**URL:** https://www.nndc.bnl.gov/qcalc/
	Description: QCalc calculates Q-values for nuclear reactions or decay. It uses mass values from the 2020 Atomic Mass Evaluation by M. Wang et al .	
Sigma	**POC:** Donnie Mason (dmason@bnl.gov)	**URL:** https://www.nndc.bnl.gov/sigma/
	Description: Evaluated (recommended) nuclear reaction and decay data from ENDF/B-VII.0, JEFF-3.1, JENDL-4.0, JENDL-3.3, CENDL-3.1, ROSFOND 2008 and ENDF/B-VI.8 libraries. Advanced plotting, browsing, and search options.	
x4i	**POC:** David Brown (dbrown@bnl.gov)	**URL:** https://github.com/brown170/x4i
	Description: x4i provides a "simple" python interface to the EXFOR library, allowing users to search for and then translate EXFOR files into an easy to understand (and then plot) form.	

Los Alamos National Laboratory		
BeoH	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** None
	Description: Code for calculating statistical decay of compound nucleus that is produced by beta-decay, fission, or any other nuclear reaction mechanisms	
CENS	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** https://github.com/toshihikokawano/CENS
	Description: Code to translate adopted discrete levels in ENSDF into a Hauser-Feshbach code readable format, such as the discrete level section in RIPL	
CGMF	**POC:** Michael E. Rising (mrising@lanl.gov)	**URL:** https://github.com/lanl/CGMF
	Description: Code for simulating emission of prompt fission neutrons and gamma rays from excited fission fragments right after scission	
CoH3	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** None
	Description: Code for calculating comprehensive nuclear reaactions in the keV to MeV energy range using the coupled-channels optical model and statistical Hauser-Feshbach theory with the pre-equilibrium process	
DeCE	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** https://github.com/toshihikokawano/DeCE
	Description: Interactive ENDF-6 formatted data manupulation code to edit/create ENDF files	
KALMAN	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** None

	Description: Parameter adjustment and production of covariance based on the Bayesian approach	
SOK	**POC:** Toshihiko Kawano (kawano@lanl.gov)	**URL:** None
	Description: Least-squares fitting code for arbitrary shape data, and production of covariance	

Lawrence Berkeley National Laboratory		
Atlas of Gamma-Ray Spectra from the Inelastic Scattering of Reactor Fast Neutrons (Baghdad Atlas)	**POC:** Aaron Hurst (amhurst@lbl.gov)	**URL:** https://nucleardata.berkeley.edu/atlas/index.html
	Description: A relational database based on the original (n,n'γ) work carried out by A.M. Demidov et al., at the Nuclear Research Institute in Baghdad, Iraq. Downloadable SQLite software platform shipped with CSV-style ASCII files for 105 datasets based on irradiation of 76 natural and 29 iostopically-enriched targets. Bundled with SQL scipts and a Jupyter Notebook enabling interaction and manipulation of the data.	
Attenuation code for Prompt Gamma Activation Analysis	**POC:** Aaron Hurst (amhurst@lbl.gov)	**URL:** https://github.com/AaronMHurst/attenuation_integration
	Description: A C++ program to calculate the attenuation integrated over the sample thickness for elemental and compound samples irradiated in prompt gamma activation analysis measurements. The software is shipped complete with mass-attenuation coefficients covering 1 keV to 20 MeV for all elements in the XMuDat database.	
Fission Induced Electromagnetic Response (FIER)	**POC:** Eric Matthews (efmatthews@berkeley.edu)	**URL:** https://nucleardata.berkeley.edu/fier/index.html
	Description: FIER analytically predicts delayed gamma-ray spectra following fission using evaluated nuclear data and solutions to the Bateman equations to calculate the time-dependent populations of fission products and their decay daughters resulting from irradiation of a fissionable isotope.	
Fission Product Yield Covavriance Matrices (COM)	**POC:** Eric Matthews (efmatthews@berkeley.edu)	**URL:** https://nucleardata.berkeley.edu/FYCoM/index.html
	Description: Covariance matrices for all of the fissioning systems of the ENDF/B-VIII.0 and JEFF-3.3 evaluations created using a constrained Monte-Carlo resampling approach.	
Global Heavy Charged-Particle Decay Database (BEApR)	**POC:** Jon Batchelder (JCBatchelder@lbl.gov)	**URL:** https://nucleardata.berkeley.edu/research/betap.html
	Description: A complete compilation of decay data from proton-rich nuclei that decay through the emission of protons and alphas from Tz = -7/2 to Tz = +33/2 are currently included, with additional Tz groups still to be included up to the heaviest nuclei known (Tz = +32). This database will be updated as new papers are published. Information from this database can currently be downloaded as a pdf document as we are developing a more useful format for future dissemination.	

NucScholar	**POC:** Walid Younes (WYounes@lbl.gov)	**URL:** https://nucscholar.lbl.gov/
	Description: NucScholar is a project to automate the processing of nuclear science literature to simultaneously boost researcher productivity while lowering the effort required to maintain important databases.	
Nuclear Structure Experimental Issues (NSEI)	**POC:** Aaron Hurst (amhurst@lbl.gov)	**URL:** https://nucleardata.berkeley.edu/nsei/
	Description: The NSEI website is provides a mechanism for nuclear data evaluators and the low-energy community, in general, to raise awareness of issues in nuclear structure data. Users enter a brief description of the issue they would like to raise, and a committee will make researchers in the field who might be interested in helping to resolve the problem aware of the issue.	
Python Archive of Coincident Emissions from ENSDF (paceENSDF)	**POC:** Aaron Hurst (amhurst@lbl.gov)	**URL:** https://pypi.org/project/paceENSDF/ and https://github.com/AaronMHurst/pace_ensdf
	Description: paceENSDF is an open-source Python-based software package enabling access, manipulation, analysis, and visualization of the radioactive decay data from the Evaluated Nuclear Structure Data File (ENSDF) archive and corresponding gamma-gamma and gamma-X-ray coincidence relationships derived from the original ENSDF-sourced datasets. The library is based on a representative JSON-format for 3254 radioactive-decay datasets (parsed from the September 2023 ENSDF archive) encompassing 834 alpha-, 1141 beta-minus and 1279 electron-capture/beta-plus decay datasets. The software package is also bundled with a Reference Input Parameter Library (RIPL)-translated format of the corresponding decay-scheme data in addition to JSON data structures for the derived coincidence gamma-gamma and gamma-X-ray datasets.	
Python library for the Evaluated Gamma-ray Activation File (pyEGAF)	**POC:** Aaron Hurst (amhurst@lbl.gov)	**URL:** https://pypi.org/project/pyEGAF/ and https://github.com/AaronMHurst/python_egaf
	Description: pyEGAF is an open-source Python-based software package enabling interaction, maipulation, analysis, and visualization of the thermal neutron-capture gamma-ray data in the Evaluated Gamma-ray Activation File (EGAF) based on the prompt gamma activation analysis measurements carried out at the Budapest Research Reactor (BRR). The library comes complete with ENSDF-, RIPL-, and JSON-formatted databases for all 245 isotopes measured at the BRR.	
Scintillator library	**POC:** Bethany Goldblum (bethany@lbl.gov), Thibault Laplace (lapthi@berkeley.edu)	**URL:** https://scintillator.lbl.gov/
	Description: The website provides measured scintillation properties of many inorganic and organic scintillating materials including scintillator response to recoil nuclei along with citations to published papers in which the original measurements were reported.	

Lawrence Livermore National Laboratory		
Ferdinand, Translate R-matrix Evaluations	**POC:** Ian Thompson (thompson97@llnl.gov)	**URL:** https://github.com/LLNL/ferdinand
	Description: Code for reading input files for R-matrix codes fresco, sfresco, eda, amur, rac, azure and standard formats endf and gnds, to translate between them.	

	Can also convert between widths and amplitudes, and generate various kinds of reconstructed cross sections.	
Frescox, Scattering code for coupled-channels calculations	**POC:** Ian Thompson (thompson97@llnl.gov)	**URL:** https://github.com/LLNL/Frescox
	Description: Documentation at https://www.fresco.org.uk/frescox.htm	
Rflow, R-matrix methods for fitting EXFOR data using tensorflow	**POC:** Ian Thompson (thompson97@llnl.gov)	**URL:** https://github.com/LLNL/Rflow
	Description: An R-matrix evaluation and fitting code that reads and writes gnds parameter files. Calculations performed using Tensorflow, which uses GPUs when available otherwise using CPUs with openmp.	

Michigan State University, Facility for Rare Isotope Beams		
AME-NUBASE viewer	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://github.com/IAEA-NSDDNetwork/AME-NUBASE-viewer
	Description: A useful program to provide easy and customized retrieval of AME (Atomic Mass Evaluation) entries and NUBASE (evaluation of ground-state and isomer properties) entries. It can also be used to update Q records in Adopted datasets automatically for ENSDF evaluation.	
ConsistencyCheck code	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://github.com/IAEA-NSDDNetwork/ConsistencyCheck
	Description: The program recommended by USNDP and NSDD to check data consistency among ENSDF datasets, group levels and gammas, and average values from different datasets (with user selections), and more.	
Discovery of Nuclide Project (in collaboration with Michael Thoennessen of FRIB)	**POC:** Michael Thoennessen (non-USNDP member), Jun Chen (chenj@frib.msu.edu)	**URL:** https://frib.msu.edu/users/nuclides
	Description: The Discovery of Nuclides Project documents the discovery of all isotopes, with information about discovery year, authors, laboratory, country, publising journal, as well as an abstract briefly descriping each discovery and history. The project was started and led by Michael Thoennessen since 2007. Jun Chen joined in this project in 2023, has modernized the database with JSON and created a viewer/editor of the database as well as webpages to display and query those data, and will maintain the database and webpages regularly. Jun Chen's effort is within the scope of data activities supported by his grant from DOE/NP.	
EXCEL2ENSDF	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://github.com/IAEA-NSDDNetwork/Excel2ENSDF
	Description: A program widely used by XUNDL compilers and ENSDF evaluators to convert an Excel file (formatted data) to an ENSDF file and vice versa. It can be also used to perform simple operations on column data in Excel, such as multiplying a factor or adding a constant. It was originally developed for XUNDL compilation to convert Excel to ENSDF but the current version is also useful for extracting data from an ENSDF dataset to an Excel table.	

Java-RULER code	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://github.com/IAEA-NSDDNetwork/Java-RULER
	Description: The program recommended by USNDP and NSDD to calculate gamma-ray transition strengths in ENSDF file with proper propagations of large/asymmetric uncertainties including the Monte-Carlo approach for ENSDF evaluation.	
McMaster-MSU JAVA-NDS code	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://github.com/IAEA-NSDDNetwork/McMaster-MSU-Java-NDS
	Description: The official program to generate PDF outputs from ENSDF file(s) for the Nuclear Data Sheets journal and web-display of ENSDF and XUNDL databases on NNDC retrieval webpages. This program was initiated by Balraj Singh and his students at McMaster University in 2007 and was re-started by Jun Chen in 2017 at MSU.	
Other ENSDF analysis and utility codes in Java (all hosted at IAEA website)	**POC:** Jun Chen (chenj@frib.msu.edu)	**URL:** https://www-nds.iaea.org/public/ensdf_pgm
	Description: Analysis and utility codes developed at FRIB/MSU to facilitate ENSDF evaluations. Some of them replace the corresponding legacy Fortran codes and the rest are newly developed.	

Oak Ridge National Laboratory		
Computational Infrastructure for Nuclear Astrophysics (CINA)	**POC:** Michael Smith (smithms@ornl.gov)	**URL:** https://nucastrodata.org/infrastructure.html
	Description: unique online nuclear astrophysics data pipeline that enables point-and-click investigations of astrophysical impacts of nuclear data sets via the uploading, manipulation, processing, and sharing of nuclear data sets, thermonuclear reaction rates, and astrophysical simulations	
Nuclear Astrophysics Datasets	**POC:** Michael Smith (smithms@ornl.gov)	**URL:** https://nucastrodata.org/datasets.html
	Description: collection of nuclear data sets needed for research in nuclear astrophysics	
Nuclear Mass Toolkit	**POC:** Michael Smith (smithms@ornl.gov)	**URL:** https://nuclearmasses.org/compute/masses.html
	Description: online system that enables quick quantitative comparisons of evaluated, theoretical, and measured nuclear masses, and features mass measurements compiled over 2008 to 2022 by B. Singh	

Appendix C – Fiscal Year 2024 Articles authored by USNDP staff

[**2023AY02**] A.D.Ayangeakaa; R.V.F.Janssens; S.Zhu; J.M.Allmond; B.A.Brown; C.Y.Wu; M.Albers; K.Auranen; B.Bucher; M.P.Carpenter; P.Chowdhury; D.Cline; H.L.Crawford; P.Fallon; A.M.Forney; A.Gade; D.J.Hartley; A.B.Hayes; J.Henderson; F.G.Kondev; Krishichayan; T.Lauritsen; J.Li; D.Little; A.O.Macchiavelli; D.Rhodes; D.Seweryniak; S.M.Stolze; W.B.Walters; J.Wu, "Triaxiality and the nature of low-energy excitations in {+76}Ge," Phys.Rev. C 107, 044314 (2023), https://doi.org/10.1103/PhysRevC.107.044314

[**2023BRZW**] EG GNDS, "Specifications for the Generalised Nuclear Database Structure (GNDS) Version 2.0," NEA (2023), OECD Publishing, Paris, https://www.oecd-nea.org/jcms/pl_85822/specifications-for-the-generalised-nuclear-database-structure-version-2-0?details=true

[2023BU09] N.Burahmah; J.R.Griswold; L.H.Heilbronn; L.A.Bernstein; A.S.Voyles; J.T.Morrell; M.Zach; R.Copping, "{+229}Pa cross section measurements via deuteron irradiation of {+232}Th," Phys.Rev. C 108, 024609 (2023), https://doi.org/10.1103/PhysRevC.108.024609

[**2023CR03**] B.P.Crider; C.J.Prokop; S.N.Liddick; H.M.Albers; M.Alshudifat; A.D.Ayangeakaa; M.P.Carpenter; J.J.Carroll; J.Chen; C.J.Chiara; A.C.Dombos; S.Go; R.Grzywacz; J.Harker; R.V.F.Janssens; N.Larson; T.Lauritsen; R.Lewis; S.J.Quinn; F.Recchia; D.Seweryniak; A.Spyrou; S.Suchyta; W.B.Walters; S.Zhu, "New method for level-lifetime measurements with thick scintillators,"Nucl.Instrum.MethodsPhys.Res.A1055,168525(2023), https://doi.org/10.1016/j.nima.2023.168525

[**2023DE34**] S.Dede; S.D.Essenmacher; P.Gastis; K.V.Manukyan; S.A.Kuvin; H.Y.Lee; J.M.Roach; P.C.Burns; A.Aprahamian, "Electrospraying deposition and characterization of potassium chloride targets for nuclear science measurements," Nucl.Instrum.Methods Phys.Res. A1055, 168472 (2023), https://doi.org/10.1016/j.nima.2023.168472

[**2023DI12**] M.R.Dias Rodrigues, J.Mabiala, V.E.Iacob, N.Nica, B.Roeder, G.Tabacaru, K.Wang, J.Romo, D.Scriven, N.Tenpas, G.A. Souliotis, A.Bonasera, "Production of 99Mo in inverse kinematics heavy ion reactions", Radiat.Phys.Chem. 212, 111162 (2023), https://doi.org/10.1016/j.radphyschem.2023.111162

[**2023GR04**] T.J.Gray; J.M.Allmond; Z.Xu; T.T.King; et al, " Microsecond Isomer at the N=20 Island of Shape Inversion Observed at FRIB," Phys.Rev.Lett. 130, 242501 (2023), https://doi.org/10.1103/PhysRevLett.130.242501

[**2023HO14**] D.E.M.Hoff; K.Kolos; G.W.Misch; D.Ray; B.Liu; A.A.Valverde; M.Brodeur; D.P.Burdette; N.Callahan; J.A.Clark; A.T.Gallant; F.G.Kondev; G.E.Morgan; M.R.Mumpower; R.Orford; W.S.Porter; F.Rivero; G.Savard; N.D.Scielzo; K.S.Sharma; K.Sieja; T.M.Sprouse; L.Varriano, "Direct Mass Measurements to Inform the Behavior of {+128m}Sb in Nucleosynthetic Environments," Phys.Rev.Lett. 131, 262701 (2023), https://doi.org/10.1103/PhysRevLett.131.262701

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[**2023KA24**] T.Katabuchi; M.Igashira; S.Kamada; M.Tajika; N.Iwamoto; T.Kawano, "Neutron capture cross section and capture |g-ray spectrum of {+88}Sr in the stellar nucleosynthesis energy region," Phys.Rev. C 108, 034610 (2023), https://doi.org/10.1103/PhysRevC.108.034610

[2023KE09] K.J.Kelly; M.Devlin; J.M.O'Donnell; D.Neudecker; A.E.Lovell; R.C.Haight; C.Y.Wu; R.Henderson; E.A.Bennett; T.Kawano; J.L.Ullmann; N.Fotiades; J.Henderson; S.M.Mosby; T.N.Taddeucci; P.Talou; M.C.White; J.A.Gomez; H.Y.Lee, "Measurement of the {+238}U(n,f) prompt fission neutron spectrum from 10 keV to 10 MeV induced by neutrons with 1.5-20 MeV energy," Phys.Rev. C 108, 024603 (2023), https://doi.org/10.1103/PhysRevC.108.024603

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