Annual Report for FY2013

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www.nndc.bnl.gov/usndp

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I. Introduction

The USNDP Annual Report for FY2013 summarizes the work of the U.S. Nuclear Data Program (USNDP) for the period of October 1, 2012 through September 30, 2013 with respect to the work plan for FY2013 that was prepared in February 2011. The work plan and final report for the U.S. Nuclear Data Program 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 30 FTE scientific, mostly at NNSA laboratories, to be compared with 20.3 FTE scientific (permanent + postdocs + contractors) at USNDP laboratories 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.

Fiscal year 2013 was the 14th year in which the Nuclear Data Program has operated under a work plan developed by the 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 U.S. Nuclear Data Program. This is followed by an updated staff level assignment table that reflects the final distribution of effort among the tasks carried out during FY2013. Then, we continue with the detailed status of work done in FY2013. Total staff assigned to USNDP activities during the year represented 24.6 FTE.

Three senior USNDP persons retired by the end of FY2013, Coral Baglin and Richard Firestone from LBNL, and Balraj Singh from McMaster University. Dr. Singh will continue contributing to USNDP working under contract with the NNDC.

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.

Table 1 shows that the FY2013 budget decreased by 7.9%. If we don't count the $500K included in the budget for an Early Career Award to LANL, the reduction was actually 15.3%.

Table 1: Summary of the USNDP metrics in FY2001- FY2013, the definitions of the various terms follow the table.

Fiscal Year	USNDP Funding	Change	Compilations	Evaluations	Dissemination (in thousands)	Reports	Papers	Invited Talks
2001			7,139	334	667	21	25	22
2002	$4,890K		6,159	300	799	23	40	22
2003	$4,932K	+0.9%	4,975	260	966	27	40	23
2004	$5,015K	+1.7%	6,241	276	1,212	35	36	43
2005	$5,437K	+8.4%	6,623	422	1,642	74	59	42
2006	$5,099K	−6.6%	4,936	318	1,863	47	60	48
2007	$5,841K	+14.6%	5,355	366	2,239	40	56	51
2008	$5,967K	+2.2%	5,104	385	2,996	48	72	68
2009	$6,267K	+5.0%	4,047	400	3,294	26	61	56
2010	$6,549K	+4.5%	4,662	395	2,843	27	83	51
2011	$6,534K	−0.2%	4,662	479	3,252	29	96	67
2012	$6,785K	+3.8%	5,221	209	3,013	22	90	48
2013	$6,249K[*]	−7.9%	4,925	282	3,447	29	84	79

[*]:Includes an Early Career Award of $500K to LANL.

In particular:

1. **Compilations**. Compilations efforts, including NSR, CSISRS and XUNDL databases, remain on the similar level.
2. **Evaluations**. Evaluations efforts, including ENSDF and ENDF databases, remain on the similar level.
3. **Dissemination**. This year there has been 15% increase in the number of web retrievals. at BNL, the most popular product continues to be NuDat that contributes nearly 65% of data retrievals.
4. **Reports**. The number of published reports has remained approximately constant over the last three years.
5. **Papers**. The number of articles published in the refereed journals reached a new high value this year.
6. **Invited Talks**. The number of invited talks has increased compared to the last year, possibly due to ND2013.

These results must be considered satisfactory taking into account that the performance, essentially equivalent to the previous year, has been achieved in spite of the loss of more than two permanent scientific FTE.

Table 2: USNDP metrics in FY2013, numbers for FY2012 are shown for comparison.

Laboratory	Compilations		Evaluations		Dissemination (in thousands)		Reports		Papers		Invited Talks	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
ANL	21	28	0	28	40	40	0	0	14	25	2	5
BNL[1]	3,385	3,466	107	100	2,624	3,030	6	5	26	15	10	28
LANL	–	–	20	20	255	255	2	2	20	20	18	15
LBNL	–	4	24	36	–	–	8	8	2	3	10	2
LLNL	–	–	0	0	8	6	0	0	1	1	0	1
ORNL	–	–	8	8	40	40	0	0	11	11	10	13
Universities[2]	1,815	1,427	50	90	46	76	6	14	16	9	9	15
Total	5,221	4,925	209	282	3,013	3,447	22	29	90	84	48	79

[1]: BNL compilations for FY2013 consist of 2,437 NSR papers and 1,029 CSISRS reactions. BNL evaluations for FY2013 consist of 73 nuclides for ENSDF and 27 reactions for ENDF.

[2]: Universities compilations for FY2013 consist of 994 NSR papers (McMaster), 353 XUNDL datasets (McMaster), 15 Mass articles and 65 XUNDL datasets (TUNL). Universities evaluations for FY2013 consist of 50 ENSDF evaluations (McMaster).

Definitions

- *Compilations*: The sum of the new entries added to the USNDP bibliographic (NSR - papers) and experimental databases (CSISRS - reactions, XUNDL – structure data sets).
- *Evaluations*: The sum of new evaluations submitted or accepted for inclusion in the USNDP evaluated nuclear databases. Structure – number of evaluated nuclei (ENSDF), reactions – number of evaluated reactions/covariances (ENDF).
- *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, gifs, etc. accessed is not tallied.
- *Reports*: The number of technical documents (includes papers in conference proceedings) or papers other than journal publications and invited talks. No administrative documents such as meeting minutes are reported.
- *Papers*: The number of articles published in refereed journals.
- *Invited talks*: The number of presentations given at the explicit invitation of the organizers of a conference, symposium, workshop, training course, etc.

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, many of the other program participants are also involved in coordination and dissemination activities.

National and International Coordination

The NNDC, while serving as the secretariat for the program, has prepared the work plan for FY2013 in cooperation with the members of the Coordinating Committee. The NNDC Head serves as a chair of the USNDP Coordinating Committee, which consists of the Principal Investigators from each of the participating groups, and chairs the annual meeting of the program held at the Brookhaven National Laboratory. LANL chairs the Nuclear Reaction Data Working Group, and TUNL the Nuclear Structure Working Group. ORNL chairs the Astrophysics Task Force and LLNL chairs the Homeland Security Task Force.

In February 2013, DOE Office of Nuclear Physics conducted its annual Budget Briefing. Michal Herman, Toshihiko Kawano, William Horak, John Kelley, Filip Kondev, and Alejandro Sonzogni represented USNDP and made the case for the 2015 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 continues to chair the Cross Section Evaluation Working Group, which produces the ENDF/B evaluated nuclear data library for nuclear science and applied nuclear technology use. As in the past, the 2012 CSEWG meeting was held at BNL. The major topic of the CSEWG meeting was to set up priorities and responsibilities for the future work leading to the next release of the ENDF/B library.

USNDP Databases

The NNDC operates five Dell servers running the Linux operating system to support its compilation, evaluation, database maintenance, and information dissemination functions. These computers archive and serve the nuclear data produced by the U.S. Nuclear Data Program and the data obtained by other national and international collaborations. In addition, the NNDC maintains the collaboration GForge server that facilitates data and codes development and employs Subversion to keep track of changes.

The NNDC maintains seven nuclear physics databases for USNDP. These databases were updated continuously in FY2013 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

In FY2013, there were 3,477 million database retrievals - a 15% increase compared to the previous year, from the USNDP databases offered by the USNDP laboratories. Most of these retrievals, 87%, were from the NNDC web site, with NuDat as the most popular product. During FY2013, five new servers were bought to replace the existing ones that had been originally installed in 2009. Two of these servers act as web servers, two as database

servers, and one as a development server, where the journal Nuclear Data Sheets is also produced. These servers run the Linux, Apache and Tomcat software. Each server has dual 2.9-GHz 8-core processors, 128-GB RAM and 15k-RPM disk drives. This upgrade resulted in at least a four-fold gain in performance. Significant savings of more than $10K annually were also realized by migrating from the high-cost, MySQL Enterprise Edition to the cost-free but robust MySQL Community Edition. A load-balanced architecture was implemented for the Web servers which further enhanced the Web site's availability.

Major Publications

USNDP continues to publish the refereed journal Nuclear Data Sheets dedicated predominantly to nuclear structure and decay data (ENSDF evaluations). As in previous years, the December 2012 issue contained 7 articles on different aspects of nuclear reaction data evaluation. The April, May and June 2014 issues of the journals will be devoted to the publication of the ND2013 proceedings and a substantial amount of time was devoted at the NNDC to get these articles ready for publication. A 2015 issue will be devoted to publish the proceedings on the 2014 Covariance Workshop organized by LANL.

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 National Nuclear Data Center (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 Nuclear Data Sheets for A>20 and in Nuclear Physics A for A≤20.

Status of ENSDF & Nuclear Data Sheets: The ENSDF database has increased in size by roughly 2.2% over the past year. Presently there are 3246 nuclides reported. Along with many revised/updated datasets, three hundred new datasets were added to ENSDF, including 72 "Adopted Levels" datasets, 51 decay datasets and 116 reaction datasets. There were 13 articles covering 17 mass chain reviews published in the Nuclear Data Sheets. The number of "mass chains" in the review process was given as 30. An additional 40 mass chains are listed as "currently being evaluated." General usage statistics for ENSDF and products derived from ENSDF (Nuclear Data Sheets, NuDat, etc.) showed a high usage and popularity on the NNDC website and the Elsevier site.

Status of XUNDL: The XUNDL database presently carries 5390 datasets covering 2202 nuclides from over 280 mass chains. A total of 446 new datasets from about 240 articles were added to the XUNDL database in the past year. McMaster University carried the bulk of the activity (353) with TUNL (65), ANL (28) and a few others (TU Darmstadt, Krishnath College-India, Sophia-Bulgaria) also contributing. NNDC (Tuli) acts as the database manager and updates the XUNDL database as new compilations are approved by Dr. Singh. As a parallel activity, McMaster has compiled 15 current papers on mass measurements comprising data for about 130 nuclides; this information was contributed to ORNL's nuclearmasses.org webpage.

A workshop on the role and future of XUNDL was held at TUNL on May 16-17 resulting in changes in the overall process of XUNDL compilation. The formal retirement of Dr. Singh is a great concern, as he and his group continue to carry the majority of effort for XUNDL. At present McMaster, TUNL and ANL intend to continue contributing, along with new participation from ORNL (Dr. Nesaraja). A key part of recent discussions on the XUNDL activity is the need for more involvement from other data centers to participate in compilation of datasets. Even with the new organization and involvement of ORNL, Dr. Singh and his students at McMaster University carry the bulk of activities. For the XUNDL to survive into the future, other data centers must join in the activity.

Status of the NSR: A total of 3430 new articles were added to the NSR database. USNDP contributions are from B. Pritychenko (manager), E. Betak, B. Singh and J. Totans. The database is up-to-date and in good shape. Some effort is being spent to add "historically important" references. The group had some discussion of how we should deal with conference proceedings where the talks and/or contributions are distributed on memory jump-disks.

Horizontal Evaluations: A summary list of "Horizontal Evaluations" involving USNDP structure evaluators follows.

- IAEA CRP on beta-N: related to its horizontal compilation and evaluation of Pn and associated half-lives: B. Singh, T.D. Johnson, E.A. McCutchan and A.A. Sonzogni.
- Compilation and evaluation of BE2 for first 2+ states in e-e nuclei: B. Pritychenko, B. Singh, M. Birch and M. Horoi,
- IAEA-CRP on Evaluated Gamma Activation File (EGAF):R. Firestone,
- IAEA Consultants Meeting on a Database of Photon Strength Data: R. Firestone,
- IAEA-CRP on Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production: F. Kondev,
- IAEA Technical Meeting on Auger Electron Emission Following Nuclear Decay: Data Needs for Medical Applications: F. Kondev,
- Configurations & Hindered Decays of K-Isomers in deformed nuclei with A>100: F. Kondev,
- AME and NUBASE: F. Kondev,
- nucastrodata.org and the Computational Infrastructure for Nuclear Astrophysics (CINA): M.S. Smith.

Other Business and discussion

Status of ENSDF Analysis codes: The group holds the general consensus that many of our evaluation codes are in need of attention to fix several bugs. Dr. Kondev would like to see more codes supported for Apple products, and he has begun writing new script codes that meet his needs. There is a general concern over the decades old FORTRAN used for most of the analysis codes. Continued use of these analysis codes will hamper many gains of a sometimes talked about transition to XML formatting of the database. However, in general there is a lack of commitment to invest effort in support of either rewriting the analysis codes or transferring the ENSDF database to XML. In early 2014 the IAEA announced a new initiative to invest effort in maintaining and upgrading the codes used for preparation and evaluation of nuclear structure data, the first meeting of this initiative took place in June 2014 and responsibilities for code upgrades were assigned.

XML Format Transition: Caleb Matoon presented a view of LLNL's Generalized Nuclear Data project. In spite of years of dialog, at the moment there is no activity and no plan to convert the ENSDF database into an XML relational database. There are two major hurdles: firstly there is no funding to support a conversion from the 80-character ascii format into XML. Second, such a conversion would have minimal utility for evaluators since there are no plans to convert the ENSDF file processing codes into a modern form that could take advantage of strengths of XML.

IV. Nuclear Reaction Data

The nuclear reaction data effort focuses on evaluation of nuclear reaction data and the related measurement and compilation activities. The USNDP also makes important contributions to nuclear reaction model code development and improvement of reaction cross-section standards.

Reaction Data Highlights

The ENDF/B-VII.1 library was released in December, 2011 as an essential update to the VII.0 version released in 2006. This is our latest evaluated nuclear data file recommended for use in nuclear science and technology applications. To upgrade the data files, we provide modern nuclear reaction modeling, updated nuclear structure information, new experimental data, and tools for evaluating covariances based on statistical theories. The work is performed closely with the US Cross Section Evaluation Working Group (CSEWG). In March 2013, BNL organized the International Conference on Nuclear Data for Science and Technology in New York, to which USNDP made significant contributions.

BNL developed a coupled-channels method that applies the global spherical optical potential to the deformed nuclei in the rare earth region. BNL also worked on some issues concerning the scattering angular distributions calculated from the MLBW (Multi-Level Breit-Wigner) resonance formalism.

New prompt fission neutron and gamma-ray spectrum data for ^{235}U, ^{239}Pu, and ^{252}Cf were produced by using the Monte Carlo technique recently developed at LANL. A Phys. Rev. C paper published on this subject was selected as Editor's Suggestion. A new modeling for the nuclear reactions when the target is in its excited state was developed, and a new evaluation of ^{236}Np metastable state was produced for the new ENDF.

A new international effort on the evaluated nuclear data library, called CIELO (Collaborative International Evaluated Library Organisation) was initiated under the Working Party on International Nuclear Data Evaluation Co-operation (WPEC) at the Nuclear Energy Agency. USNDP takes part in producing new evaluations for the CIELO pilot project, and the evaluation status reports were presented at a workshop in Geel/Belgium in Nov. 2013.
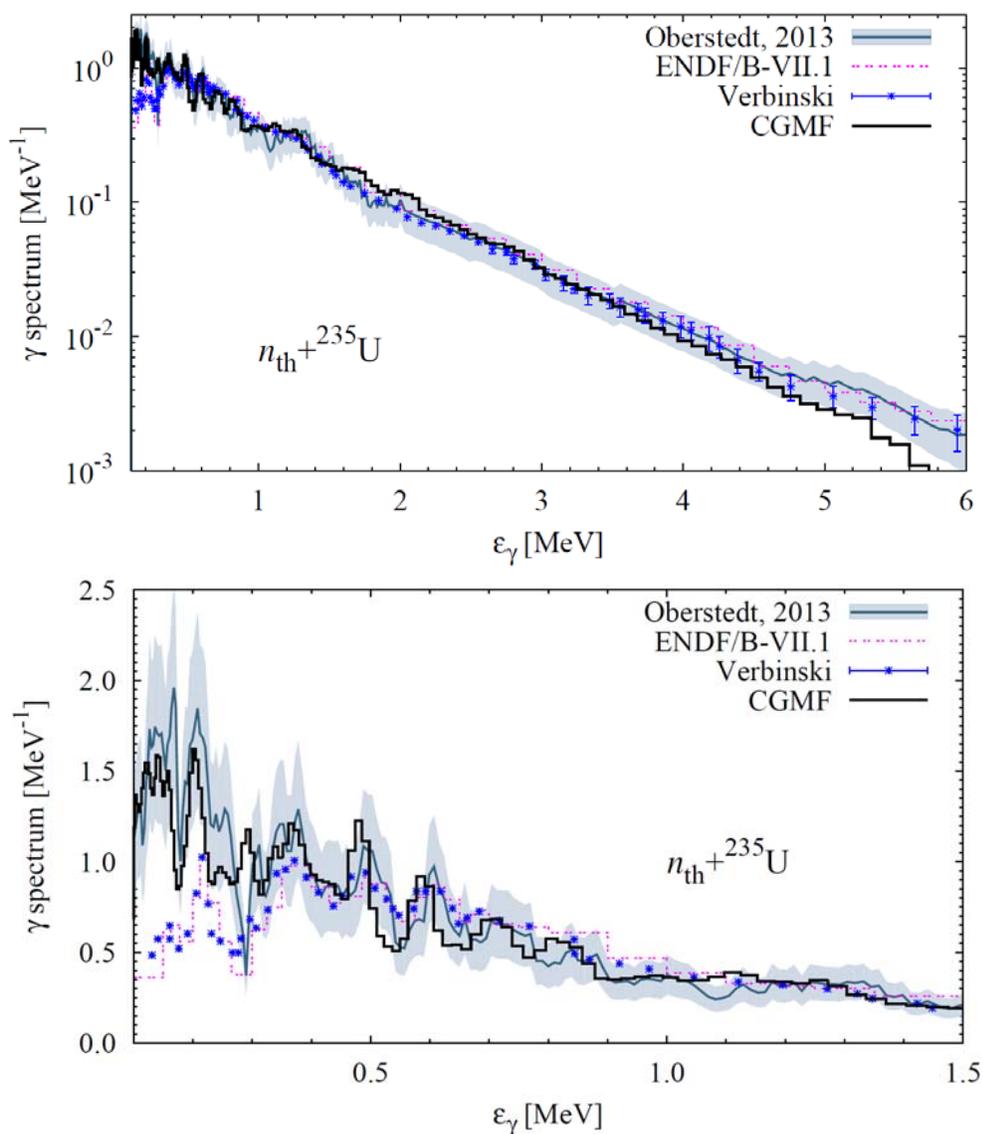
Calculated prompt gamma-ray energy spectra for the thermal neutron induced fission on ^{235}U with the Monte Carlo Hauser-Feshbach method developed at LANL (shown by the thick histogram), compared with the experimental data. The bottom panel shows the zoomed plot in the low energy region, where the structure in the spectrum evidences importance of the nuclear structure database, ENSDF.

Model Code Highlights

EMPIRE-3.2 (Malta) includes improvements of; (i) the width fluctuation correction for deformed systems, (ii) energy balance, and (iii) break-up and transfer reactions. The theoretical calculation of the ^{235}U fission cross sections in the 300 keV to 1 MeV energy region could explain the structure seen in the standards evaluation.

LANL added a new feature to CoH3, which is the prompt fission neutron spectrum calculation with the Los Alamos model, including pre-fission neutron emissions. The CGMF code, the Monte Carlo Hauser-Feshbach approach to the prompt fission neutrons and gamma-rays, applied to Cf-252 spontaneous fission neutrons, fission gamma-rays, and other observables. Integration with MCNP6 is planned for near future.

The new version of FREYA code at LLNL samples the initial angular momentum of the compound nucleus and the fragments in a way that conserves total angular momentum throughout the fission process. FREYA was also incorporated into MCNP6 to provide an event generator for neutron angular correlations and photon emissions, which is useful for detector development and simulations.

Nuclear Standards highlights

New experiments since the last standards evaluation suggest improvements have been made for the H(n,n), Li(n,t), ^{10}B(n,a), Au(n,γ) and ^{238}U(n,γ) cross sections. At the same time, inconsistencies for the ^{3}He(n,p), C(n,n), ^{238}U(n,f) and ^{239}Pu(n,f) cross sections have been revealed. There were also new measurements of the ^{235}U(n th,f) neutron spectrum made by Kornilov et al. and Vorobyev et al.

Current standards will be reevaluated using the improved combination procedure developed for the previous standards evaluation. These will involve changes to the R-matrix codes regarding uncertainty determination. A release of the new standard and reference evaluations is expected in the summer of 2016.

Nuclear Astrophysics highlights

An ORNL analysis of the structure of the exotic nucleus ^{131}Sn was published in PR. This paper also discussed the initial implications on the direct neutron capture cross section on ^{130}Sn important in the astrophysical r-process that occurs in Supernovae. Two follow-up projects are in progress - looking at systematic evolution of single particle levels in exotic Sn nuclei as a function of neutron number, and examining direct capture cross sections for a series of captures on exotic Sn nuclei. Papers are being drafted on both of these projects. An assessment of levels in ^{27}Si from a measurement of ^{26}Al(d,p) at ORNL is almost complete, and a paper has been drafted. Thermonuclear reaction rates from the NACRE II rate collection have been fit with the tools in the Computational Infrastructure for Nuclear Astrophysics and put online so that the research community can utilize them in simulations of stellar explosions. A paper has also been drafted on the structure of exotic Neon isotopes, with a detailed examination of the data and its implication for the presence of a halo structure in ^{29}Ne and ^{31}Ne. Similar techniques will be utilized to examine the structure of a number of nuclei of importance to astrophysics.

V. Additional Accomplishments

ND2013

The National Nuclear Data Center at Brookhaven National Laboratory organized the 2013 International Conference on Nuclear Data for Science and Technology, ND2013, which was held on March 4-8, 2013 at the Sheraton New York Hotel & Towers in Manhattan, NY, USA.

ND2013 was the twelfth conference in a series held every three years that began in Harwell (1978) and continued in Antwerp (1982), Santa Fe (1985), Mito (1988), Julich (1991), Gatlinburg(1994), Trieste (1997), Tsukuba (2001), Santa Fe (2004), Nice (2007) and Jeju Island (2010). The goal of these conferences is to create a forum for the presentation and discussion of all aspects of nuclear data and its applications.

A total of 452 participants from 45 different countries including 69 students and 35 post-docs attended ND2013, making the conference truly international in scope. The program included 9 plenary talks, invited presentations and contributed talks organized in 5 parallel tracks over the 5 days of the conference. ND2013 also featured two evening poster sessions.

In addition to the traditional topics covered by this series of conferences, there were two sessions and a plenary talk on nuclear reactor antineutrinos and two sessions on nuclear physics education. Moreover, three of the plenary talks were devoted to major experimental facilities in the US: FRIB at Michigan State University, CARIBU at Argonne National Laboratory and NIF at Lawrence Livermore National Laboratory.

In total there were 347 oral presentations and 120 poster contributions, resulting in 344 proceedings articles with over 1,600 different authors. These proceedings will be published in the April, May and June 2014 issues of Nuclear Data Sheets.

A few pictures of the conference are shown below.
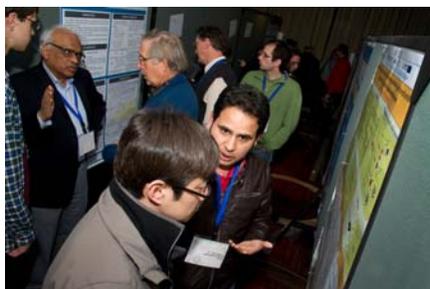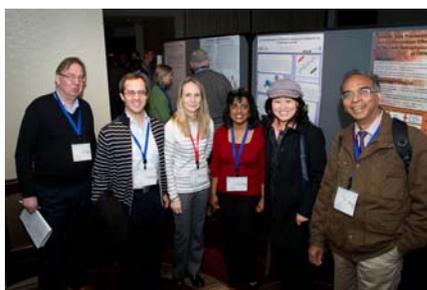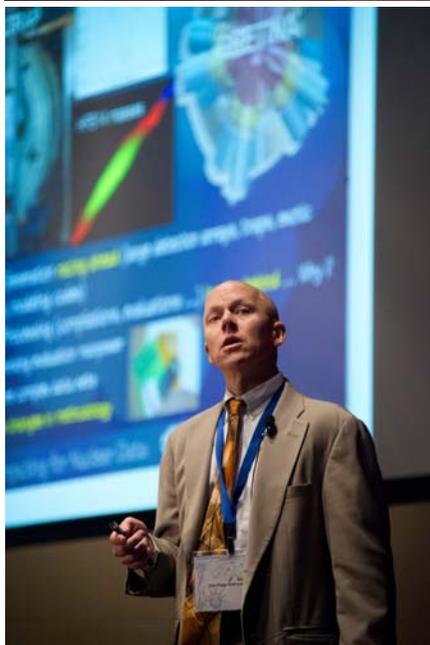
USNDP Staffing table FY2013

	ANL PhD P	ANL PhD T	BNL PhD P	BNL PhD T	BNL T/A	LANL PhD P	LANL PhD T	LBNL PhD P	LBNL PhD T	LLNL PhD P	LLNL PhD T	McMaster PhD P	McMaster PhD T	NIST PhD P	NIST PhD T	ORNL PhD P	ORNL PhD T	TUNL PhD P	TUNL PhD T	TUNL T/A	Sum
I. NNDC Facility Operation			0.60		1.45																2.05
Management			0.60																		0.60
Secretarial/Administrative Support					0.80																0.80
Library					0.15																0.15
Computer Operations					0.50																0.50
II. Coordination	0.10		1.87			0.25		0.10		0.26						0.05					2.63
National Coordination			0.73			0.05		0.05		0.20						0.05					1.08
International Coordination	0.10		1.14			0.20		0.05		0.06											1.55
III. Nuclear Physics Databases			1.02	0.80							0.12										1.94
Nuclear Science References, NSR			0.20	0.70																	0.90
Exper. Nucl. Structure Data, XUNDL			0.05																		0.05
Eval. Nucl. Structure Data, ENSDF			0.25																		0.25
Numerical Nuclear Data, NuDat			0.05																		0.05
Reaction Data Bibliography, CINDA																					
Experimental Reaction Data, CSISRS			0.05																		0.05
Evaluated Nuclear Data File, ENDF			0.32																		0.32
Database Software Maintenance			0.10	0.10																	0.20
Future Database System Develop.											0.12										0.12
IV. Information Dissemination			0.80	0.30	1.00											0.75				0.60	3.45
Nuclear Data Sheets			0.10	0.30	0.75																1.15
Customer Services			0.10		0.15																0.25
Web Maintenance & Development			0.60		0.10											0.75				0.60	2.05
V. Nuclear Structure Physics	0.80		1.80	1.05		0.10				1.50		0.75	0.20			0.80	0.15	0.75	0.10	0.15	8.15
NSR Abstract Preparation			0.25	0.25								0.15									0.65
Compilation of Exper. Structure Data	0.10		0.05									0.20	0.10			0.10					0.55
Eval. of Masses & Nuclides for ENSDF	0.50		1.00	0.80				1.00				0.40	0.10			0.80	0.15	0.33		0.15	5.23
Ground & Metastable State Properties			0.05																		0.05
Radioactive Decay Data Evaluation	0.10																				0.10
Thermal Capture Gamma Data Eval.								0.50													0.50
Light Mass Eval. for Nucl. Physics A																		0.33	0.10		0.43
Nuclear Structure Data Measurement	0.10		0.30			0.10															0.50
ENSDF Evaluation Support Codes			0.15																		0.15
VI. Nuclear Reaction Physics	0.10		1.51	2.60	0.30	0.95	0.25	0.30						0.10	0.10	0.10					6.31
Experimental Data Compilation			0.25	0.50																	0.75
ENDF Manuals and Documentation			0.02																		0.02
ENDF Evaluations			0.40	0.70		0.30															1.40
Nuclear Reaction Standards						0.10								0.10	0.10						0.30
Nuclear Model Development			0.14	0.60		0.10	0.05	0.10													0.99
Nucl. Reaction Data Measurements						0.30	0.20	0.20													0.70
Astrophysics Nuclear Data Needs	0.10		0.10	0.50		0.10										0.10					0.90
Covariances development			0.40	0.30		0.05															0.75
Reactor anti-neutrino & decay heat calculations			0.10																		0.10
Verification and Validation			0.10	0.30																	0.40
DOE-SC Nucl. Data Funded Staff	1.00		7.60	3.95	3.55	1.30	0.25	1.90		0.26	0.12	0.75	0.20	0.10	0.10	1.70	0.15	0.75	0.10	0.75	24.53
Staff Supported by Other Funds		1.00	0.40			12.70	5.75		3.00	4.50	0.50			2.50							30.35
TOTAL STAFF	1.00	1.00	8.00	3.95	3.55	14.00	6.00	1.90	3.00	4.76	0.62	0.75	0.20	2.60	0.10	1.70	0.15	0.75	0.10	0.75	54.88

PhD P: PhD Permanent,
PhD T: PhD Temporary,
T/A: Technical and administrative,
GS: Graduate student.

Detailed Status of the Work Plan
Fiscal Year 2013 Report

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 and the U.S. nuclear reaction and nuclear structure data evaluation and international nuclear structure evaluation effort.

C. Computer Operation

The NNDC operates several servers running Red Hat Enterprise Linux in support of its compilation, evaluation, database maintenance, and information dissemination functions. In addition, each staff member has a PC that supports an interface to these Linux servers and supports administrative functions such as word processing and email. Furthermore, MS Windows servers provide centralized backup, printing and file serving for the PCs. This task includes software upgrades, hardware and software procurements, machine operations and internal user support for both the Linux and Windows platforms.

BNL planned activities	Status
Ensure compliance with DOE cyber security requirements through regular network scannning and vulnerabilities remediation on NNDC servers and clients. Noncompliance could result in a total block of a machine from network access.	Daily and quarterly scanning were performed and vulnerabilities were promptly remediated. As a result, NNDC computers fully met DOE cyber security requirements and maintained 99.9% availability.
Provide computer support to NNDC staff and visitors in their use of NNDC computing resources. Also provide remote assistance to external NNDC collaborators in their use of BNL's Web-accessible scientific publications.	Prompt and quality technical support were provided to NNDC staff, visitors and external collaborators resulting in timely completion of work and generation of good results.
Upgrade and maintain NNDC's Linux cluster to handle CPU-intensive calculations due to data verification and data validation of new and revised nuclear data evaluations, and COMARRA-related covariance processing.	Smooth daily operation of the Linux cluster was maintained through prompt resolution of system-related issues and quick recovery from disk crashes.
Upgrade and maintain NNDC's continuous integration server (CruiseControl) and provide technical support to its end-users.	Smooth daily operation of the server was maintained and quality technical support was provided to the ADVANCE system programmer for the development of new capabilities.
Maintain NNDC's GForge server, the collaboration platform for the U.S. nuclear data community, and provide technical support to its end-users.	GForge server software was upgraded from version 6.0 to 6.2.1 which provided end-users with new functionalities.
Conduct regular backup of mission-critical servers to minimize loss of data and staff productivity during system failures.	Continued performing regular, centralized backups which enabled recovery from a server disk crash and accidental deletion of files/directories by end-users.

II. Coordination

A. National Coordination

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

ANL: Chair the Covariance Committee the Cross Section Evaluation Working Group.

ANL Planned Activities	Status
Organize and chair the CSEWG Covariance Committee	Completed.

BNL: Chair USNDP Coordinating Committee, chair Cross Section Evaluation Working Group, develop USNDP work plan, and maintain its USNDP website.

BNL planned activities	Status
Prepare FY2014 work plan for USNDP in time for spring 2013 FWP submittals.	FY2014 work plan has been prepared in June 2013 and posted on the NNDC Web-site.

Organize and chair CSEWG Meeting at BNL in November 2013.	The CSEWG meeting was organized and held at BNL in November 2013.
Organize and chair USNDP Meeting at BNL in November 2013.	The USNDP meeting was organized and held at BNL in November 2013.
Edit and publish summary reports and proceedings of the CSEWG and USNDP meetings.	Joint minutes for the 2013 USNDP and CSEWG meetings were prepared and published on the NNDC Web-site.
Maintain CSEWG and USNDP websites	CSEWG and USNDP Web sites were maintained reflecting preparations for the annual meetings.
Host ND2013.	ND2013 took place in May 2013. More details about it can be found earlier in the report.
Organize and chair the CSEWG Task Force on Nuclear Data Needs for Homeland Security.	Chair responsibilities handed off to R. Vogt (LLNL).

LANL planned activities	Status
Organize and chair CSEWG Evaluation Committee meeting at BNL, November 2012.	Organized and chaired CSEWG Evaluation Committee meeting at BNL, November 2013.
Organize and chair Nuclear Reaction Working Group meeting at USNDP meeting in November 2012.	Organized and chaired Nuclear Reaction Working Group meeting at USNDP meeting in November 2013.
Help organizing ND2013.	Helped organizing Nuclear Data Conference in New York, 2013, and served international committee members.

LBNL: Serve as a member of the USNDP Coordinating Committee and chair the USNDP Nuclear Structure and Decay Data Working Group in addition to overseeing, coordinating, and directing the work of members of the Isotopes Project. The latter effort includes working with LBNL management, with other members of the USNDP, and with the program officers of the DOE.

LBNL planned activities	Status
Coordinate the LLNL/LBNL ENDF Gamma-ray Library project to use EGAF data to improve capture gamma ray data in ENDF.	EGAF and neutron capture cross section of ^{23}Na(n,γ) and ^{182,183,184,186}W(n,γ) were published in Phys. Rev. C and ^{155,157}Gd(n,γ) in Nuclear Science & Engineering.

LLNL: Chair the Task Force on Nuclear Data Needs for Homeland Security of the Cross Section Evaluation Working Group.

LLNL planned activities	Status
Organize and chair the CSEWG Task Force on Nuclear Data Needs for Homeland Security.	R. Vogt has taken over responsibility for chair of task force. No session was held at annual USNDP meeting.

ORNL: Chair the Astrophysics Task Force, and help facilitate and coordinate nuclear astrophysics data work at different labs to advance USNDP goals; provide leadership in planning future activities in nuclear data for nuclear astrophysics

ORNL planned activities	Status
Summarize USNDP efforts in nuclear data for nuclear astrophysics at USNDP Meeting in November 2012.	Completed - astrophysics activities were discussed at the USNDP Meeting.
Communicate current efforts and future plans with researchers in nuclear astrophysics data.	Completed - extensive discussions on nuclear astrophysics data, leading to exchange of databases, occurred between ORNL and MSU / Joint Institute for Nuclear Astrophysics.
Represent USNDP nuclear astrophysics efforts at international collaboration meetings on nuclear astrophysics data.	Completed - discussions on nuclear astrophysics data were held at numerous international meetings. M.S. Smith co-chaired a session on nuclear astrophysics data at the Oct. 2012 Astrophysics Town Meeting, and discussed USNDP efforts in seminars and meetings in Korea and China.
Initiate collaborative research projects to raise the visibility of nuclear data projects directed at astrophysics applications.	Completed - there were a number of discussions between ORNL and ANL efforts on the importance of a horizontal evaluation of beta decays of nuclei of interest to astrophysics.
Discuss future plans in nuclear astrophysics data with DOE, with USNDP/NNDC, and with other agencies.	Completed - plans for streamlining evaluations and putting more codes online were discussed during a meeting [on another topic] at DOE HQ.

B. International Coordination

ANL: Represent the ANL in IAEA-sponsored Nuclear Structure and Decay Data Network (NSDD) and Decay Data Evaluation Project. Participate in IAEA-sponsored coordinated research programs (CRP) and training workshops.

ANL planned activities	Status
Participate in the 2013 NSDD meeting	ANL staff participated in the NSDD meeting in Kuwait City.
Participate in the DDEP collaboration meeting	ANL staff participated in the DDEP Workshop in Paris, France.
Host several international visitors to ANL to collaborate on nuclear structure and nuclear astrophysics data evaluation projects.	Hosted S. Erturk and A. Jain (ENSDF) and M. Wang and G. Audi (AME).

BNL: Represent the United States in IAEA-sponsored Nuclear Reaction Data Center Network (NRDC) and Nuclear Structure and Decay Data

Network (NSDD). The NNDC center head is the U.S. member and vice-chair of the IAEA's International Nuclear Data Committee (INDC), the lead US member of the NEA Working Party on International Evaluation Cooperation (WPEC) in his position as chair of CSEWG. Many of the NNDC staff participates in IAEA sponsored activities such as Workshops and Technical Meetings.

BNL planned activities	Status
Participate in the IAEA-sponsored NRDC meeting in FY2013.	NNDC EXFOR database manger Boris Pritychenko participated in the NRDC meeting in Vienna.
Participate in NEA WPEC annual meeting in 2013.	M. Herman, S. Hoblit, D. Brown and A. Sonzogni participated in the meetings of WPEC subgroups in May 2013 in NEA Headquarters in Paris. M. Herman led the US delegation at the WPEC meeting.
Participate in the IAEA-sponsored NSDD meeting.	M. Herman, J. Tuli, and E. McCutchan participated in the NSDD meeting in Kuwait City.
Lecture at the IAEA-sponsored workshops (including ICTP at Trieste) if such are organized.	No training workshops took place in FY2013.
Host ND2013.	ND2013 took place in May 2013. More details about it can be found earlier in the report.

LANL: Participate in and chair international nuclear reaction data collaborations. This insures that the U.S. benefits from breakthroughs around the world, and plays a leadership role in new developments. LANL staff members participate in NEA/WPEC committees on covariance data and international model code development cooperation. LANL will host visits by foreign scientists with international reputations to benefit from the exchange of information and ideas.

LANL planned activities	Status
Participate in NEA-WPEC 2014 meeting	One person participated in NEA/WPEC 2013 meeting in Paris.
Participate in relevant IAEA CRP meeting (prompt fission neutron spectrum data).	One person participated in prompt fission neutron spectrum meeting, and one person participated in a technical meeting on reference input library for nuclear fission at IAEA.
Make latest version of NJOY data processing code available to the international community.	Updated NJOY2012 made available to the international community.
Host a couple of international visitors to LANL to collaborate on the evaluation of reaction data.	We invited A.Trkov Institute of Jozef Stefan in slovenia, and G. Chiba of Hokkaido University to discuss on nuclear data processing issues.
Participate in the International Advisory Committee and the International Advisory Committee for ND2013, the International Conference on Nuclear Data for Science and Technology	Two persons in LANL served the Int. Advisory Committee and 4 persons served the Int. Program Committee members for ND2013.
Participate and give a talk at the workshop on compound nucleus and related topics, CNR13, 2013, Sao Paulo.	One person gave a talk at CNR13. There was another person, who was invited to give a talk, had to cancel his trip due to a complicated situation at that time.

LBNL: Participate in IAEA-sponsored training workshops, planning meetings and coordinated research programs on nuclear structure and decay data.

LBNL planned activities	Status
Coordinate the evaluation of a new k0/cross section database with the IUPAC k0 users committee.	Discontinued due to staff retirement and short of manpower.
Evaluate and maintain the IAEA/LBNL Evaluated Gamma-ray Activation File.	Seven isotopes of sodium, tungsten, and gadolinium are evaluated for EGAF and several others in progress.
Contribute updated nuclear structure data to the IAEA RIPL data file.	Updates were done for sodium and tungsten isotopes.
Evaluate neutron activation decay data in collaboration with the DDEP	Activity did not take place.

McMaster: Continue participation in new evaluators training program.

McMasters planned activities	Status
Participate in the matters related policies, ESNDF formats and procedures for the NSDD network.	Participated in discussions about formats and policies of ENSDF at US-NDP-2012 and NSDD-2013, in particular about single gamma levels in Adopted datasets. Sent to NNDC several revisions of Adopted datasets in ENSDF where intensity of gamma transitions were added.
Continue to participate in training/mentoring of new ENSDF evaluators through collaborative work.	Participated in ENSDF wokshop at VECC, Kolkata, India: two lectures, coordination of evaluation of A=215 mass chain for ENSDF (now published in NDS)
Participate in IAEA-NSDD 2013 meeting.	Participated in IAEA-NSDD meeting in Kuwait January 2013. Presented McMaster center status report, XUNDL-status report, and a report on horizontal evaluation of B(E2) and Beta-delayed neutron data in collaboration with NNDC, BNL.
Unplanned activity	Participated in IAEA-CRP related beta-delayed neutron workshop at ORNL in June 2013; and 1st RCM at IAEA-Vienna in August 2013. One invited talk at each of the two meeings.

Unplanned activity	Dr. Anagha Chakraborty from India and Dr. Alexander Rodionov visited McMaster center for about 3 weeks each for consultation with both on ENSDF evaluations, and with Dr. Chakraborty about continued analysis of data for an experiment on structure of Zr-94 carried out at TRIUMF laboratory in 2012.

ORNL: Represent ORNL at IAEA-sponsored meetings.

ORNL planned activities	Status
Participate in the policy matters related to the NSDD network.	C. Nesaraja participated in the 2013 NSDD meeting in Kuwait

TUNL: Represent TUNL at IAEA-sponsored at Nuclear Structure and Decay Data network (NSDD).

TUNL planned activities	Status
Participate in the policy matters related to the NSDD network.	Continuing.
Participate in NSDD/IAEA meetings	Continuing.

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 done on a continuing basis. The preparation of NSR entries is given under Nuclear Structure Physics.

BNL planned activities	Status
Database distributed to collaborators monthly.	Database was regularly provided to the IAEA.
Provide international coordination of NSR compilations and activities.	NSR compilations were coordinated internally using the Web, operational meetings and personal contacts.

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 compilation work is mainly carried out at McMaster University. The McMaster group also coordinates this work with that of other centers. The NNDC updates the database as new/revised data sets are received from McMaster.

BNL planned activities	Status
Weekly update of the database using input received from McMasterUniversity.	Database updated as soon as updates received from McMaster. External database updates every weekend.
Distributed twice a year to the NSDD network.	Database distributed twice during the year.

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 format and content checking, preparation of 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 continuing basis.

BNL planned activities	Status
Database distributed to NSDD network twice a year and to researchers when requested.	Database distributed twice during the year.
Process evaluations received from NSDD evaluators.	Evaluations processed as soon as received from the evaluators. A monthly report is sent out to indicate the current status.

D. Numerical Nuclear Data File (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 meta-stable state properties (Wallet Cards), atomic and nuclear radiations derived from ENSDF, and thermal neutron cross sections and resonance integrals. Additionally, NuDat contains an interactive Chart of Nuclides and interactive level schemes.

BNL planned activities	Status
Update NuDat database as necessary, about 10 times a year.	Completed.

E. Neutron Reaction Data Bibliography (CINDA)

The NNDC continues to contribute to the CINDA database that contains references to nuclear reaction data in the published and unpublished

literature. Since 2004, CINDA also contains bibliography information on charged-particle and photonuclear reactions. The database serves as an index to the data contained in the experimental database, CSISRS. The database is maintained by the Nuclear Data Section, IAEA Vienna.

BNL planned activities	Status
Contribute to CINDA by compiling experimental cross-section data to the CSISRS database (120 compiled papers expected). Provide NSR data for CINDA updates.	EXFOR compilations and NSR content was available for CINDA updates.

F. Experimental Reaction Data File (CSISRS)

The NNDC is responsible for maintaining the CSISRS 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 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
Update EXFOR database with new compilations from cooperating centers (~500 entries expected). The NNDC compilation work can be found under Nuclear Reaction Physics, chapter VI of the present document.	EXFOR database was regularly updated on a monthly basis, database Web interface was upgraded.

G. 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 Cross Section Evaluation Working Group (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 about 35 years ago, 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 for the U.S. ENDF/B library, the distribution of this database in the United States and the exchange of libraries internationally. New evaluations for the next release of the library, ENDF/B-VII.1, are assembled, tested and made available to users through NNDC's Web servers and GForge collaboration server.

BNL planned activities	Status
Maintain Linux/MySQL database system.	The ENDF database system was maintained at kept operational throughout the year.
Maintain GForge/Subversion system for tracking development of the ENDF/B library.	GForge server was upgraded from version 6.0 to 6.2.1 which provided new functionalities to the ENDF/B project collaborators.
Maintain and improve Sigma database and web interface for users without specialized knowledge of ENDF-6 format. (See also information dissemination, chapter IV).	Sigma database and related Web retrieval system was operational throughout the year.
Perform data verification and data validation on new and revised evaluations submitted to the ENDF/B library. Present results in library pre-release meetings conducted by CSEWG.	All new evaluations were subject to the quality assurance (QA) at the NNDC.

H. Database Software Maintenance

This activity includes software bug fixes and enhancements for the six nuclear physics databases maintained by NNDC.

BNL planned activities	Status
Fix bugs and develop enhancements for the nuclear physics databases maintained by NNDC.	Completed. In particular, Webtrend was updated.

I. Database Systems Development

The multi-year effort to migrate the USNDP databases to a LINUX/MySQL environment was completed in FY2009. Afterwards, several follow-up tasks needed to be performed. A new web interface, complementary to the existing one, should be developed to facilitate the retrieval of experimental data in CSISRS by non-ENDF users, such as nuclear astrophysicists. This interface should focus on the relevant experimental data, such as a full reference to the publication, a comprehensive reaction description and the experimental data. The existing interface, giving access to the complete compilation (with more details than the reference, reaction and data) will be retained and will still be accessible to users who need it. Also, a new ENDF interface should be developed for users who do not possess specialized knowledge of ENDF-6 format.

BNL planned activities	Status
Maintain Linux/MySQL database system and continuously fine tune its performance.	Migrated databases from the high-cost, Oracle-supported MySQL DBMS software to the cost-free, community-supported but robust edition.
Implement and maintain automatic replication of updates from the internal MySQL database server to the external.	Perfomed weekly replication of database updates from the internal MySQL server to the external.

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. 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 Web site. The NNDC Web services are powered by five Dell servers, each one has dual 2.9-GHz 8-core processors, 128-GB RAM and 15k-RPM disk drives Other USNDP members also offer nuclear physics information through their websites. These services require resources to maintain currency and improve performance.

ANL Planned Activities	Status
Maintain and upgrade the ANL/NDM report series web site.	Maintained and upgraded the web site, as needed.
Maintain and upgrade Experimental Resources for Nuclear Data web site.	Maintained and upgraded the web site, as needed.
Maintain and upgrade ANL Nuclear Data Information web site.	Maintained and upgraded the web site, as needed.

BNL Planned Activities	Status
Maintain and improve ENSDF/XUNDL web interface.	Several changes were implemented based on user feedback.
Maintain web interfaces for NSR, ENDF and EXFOR databases.	Web Interfaces for NSR, ENDF and EXFOR were updated to accommodate possible SQL injections.
Improve Sigma web interface by adding new and enhanced features following user's requests.	Completed.
Maintain web interfaces for double-beta decay, B(E2) and Maxwellian-averaged cross sections and reaction rates.	Web Interfaces for double-beta decay, B(E2) and Maxwellian-averaged cross sections and reaction rates were updated to accommodate possible SQL injections.
Maintain currency of the CSEWG, USNDP and the NNDC web sites, proactively respond to the users requests.	This was done, including adding to and maintaining the USNDP/CSEWG nuclear data week meeting page for both 2013 and 2014.
Improve reliability of web services by installing the latest version of Apache/Tomcat servers and mod-jk connector software for a new dual web server system. Maintain the NNDC Web Services readiness above the 99% level.	Migrated NNDC Web Services to new and more powerful Linux servers. Implemented a new architecture for the deployment of Web applications. On the overall, NNDC Web Services availability improved significantly.
Strictly follow all BNL and DOE cybersecurity rules and regulations during the Web application design, development and implementation. Patch immediately security vulnerabilities discovered during network scans.	Performed daily light scans and quarterly full scans on NNDC computer network and remediated promptly dicovered vulnerabilities. As per DOE's annula security and safety audit, the NNDC computer network remained fully compliant.
Maintain GForge Web site.	GForge server software was upgraded from version 6.0 to 6.2.1 which provided new functionalities to end-users.
If the proposed Generalized Nuclear Data (GND) format is approved by CSEWG, extend the Sigma web interface to use reaction data in the GND format.	WPEC Subgroup 38 is developing a successor format based on GND. CSEWG has determined that the ENDF library will be released in this new format when it is ready. At this point there is no need to add GND to the the Sigma web interface. That said, GND formatted evaluations are available in other parts of the NNDC website.

LANL Planned Activities	Status
Maintain LANL web site and provide actinide ENDF/B-VII data for criticality data testing, together with other LANL evaluations.	LANL web site provided ENDF data for nuclear data users. However the effort remains at the maintenance level.

LLNL Planned Activities	Status
Maintain LLNL's Nuclear and Atomic Data Viewer.	No maintenance has been undertaken and data viewer is starting to show signs of neglect. Currently not functioning due to java issues.

LBNL planned activities	Status
The Isotopes Project web site continues to operate and will be upgraded in collaboration with the UC Berkeley Nuclear Engineering Department.	http://ie.lbl.gov/toi/ web site serving the community. However an anticipated upgrade to support the local applied nuclear activities were not pursued this year.

ORNL Planned Activities	Status
Continued development and maintenance of our online software suite to convert nuclear data to astrophysical reaction rates and plot, manipulate, and share results online; this activity is at risk of termination.	Continuing. Recent accomplishments include fitting the NACRE II reaction rates in a format that can be used by the entire nuclear astrophysics community in simulations of explosion simulations.

TUNL Planned Activities	Status
Continue to improve the TUNL website and provide access to new information on A = 3 - 20 nuclei.	Continuing.
Continue to prepare new PDF and HTML documents of the most recent TUNL reviews.	Continuing.
Continue to provide PDF and HTML documents for FAS reviews for the A = 3 - 20 series with the most current NNDC reference keys and with the direct hyperlink of reference with TUNL keys.	We have completed FAS reviews from year 1984 to 1991.
Continue to provide Energy Level Diagrams (in GIF, PDF and EPS/PS formats) to accompany the PDF and HTML documents for the most recent TUNL reviews and preliminary reports, and for the earlier FAS reviews.	Continuing.
Provide compiled and evaluated data on the decay of unstable ground states and on structure data from thermal neutron capture.	Continuing.
Provide compiled data related to the level parameters for A = 3 – 20 nuclei populated in proton- and alpha-particle-induced reactions.	Continuing.
Provide online access of TUNL dissertations collection.	More than 90% of TUNL Ph.D. dissertations have been collected.

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" and for administrative/clerical support of its customer services.

BNL Planned Activities	Status
Provide technical support to users as necessary.	All e-mail requests addressed by the users to the NNDC staff were properly addressed and necessary support was provided.
Maintain Comments/Questions option for all reaction databases, for the NNDC web services, ENDF, EXFOR.	Comments/Questions options for the reaction databases were maintained although it has been noted that this form of communication with the users is loosing it's popularity.
Modernize help systems for the Web based data retrieval.	This action was postponed in view the major modernization of the NNDC Web services to be initiated in FY 2015.

C. Publications

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 published by Elsevier and various versions of the Nuclear Wallet Cards.

BNL Planned Activities	Status
Prepare eleven issues of Nuclear Data Sheets based on ENSDF evaluations for publication.	Eight issues of Nuclear Data Sheets were published.
Prepare special issues of Nuclear Data Sheets with proceedings of the ND2013 conference.	Work on preparing three issues of NDS with ND2013 proceedings has been carried out starting just after the conference in March 2013 and continuing through the end of the fiscal year.
Distribute Nuclear Wallet Cards as per requests from users.	Distribution done as per the requests.

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. The IAEA is expected to provide more than 20% of the keywords. 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
Prepare entries for about 3,100 new references, and keyword abstracts for 2,000 of them.	3,430 new references and 1,822 key-worded abstracts were added to NSR.
Check and edit approximately 700 key-worded abstracts for two European journals prepared at Institute of Physics, Slovak Academy of Sciences.	All submissions from Slovak Academy of Sciences were verified.
Check and edit key-worded abstracts from other collaborators as applicable and necessary.	All submissions from other collaborators other collaborators were verified.
Provide training and knowledge sharing for external NSR collaborators.	NSR best practices were shared with external collaborators.

McMaster Planned Activities	Status
NSR keywording for Physical Review C journal	Consulted 1200 papers in PRC; prepared keywords for 800.

B. Compilation of Experimental Structure Data

This activity involves compilation of recently published or completed experimental nuclear structure data for inclusion in XUNDL. The compilation is done by McMaster, while the NNDC is maintaining the database. In FY09, ANL plans to start contributing to compilation effort.

ANL Planned Activities	Status
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.	28 datasets were submitted for inclusion into the XUNDL database.

BNL Planned Activities	Status
Compile new B(E2) experimental data. Continue work on a B(E2) evaluation project (in collaboration with McMaster and Central Michigan Universities).	28 new nuclei were compiled. B(E2) evaluation was completed and paper was submitted to ADNDT journal.
Compile new double-beta decay experimental data. Produce a new double-beta decay evaluation.	38 new entries were compiled. Double-beta decay was produced and submitted to NDS journal.
Maintain, update and distribute XUNDL.	204 new datasets added to the database. File updated weekly and distributed twice a year.

McMaster Planned Activities	Status
Compile data sets (in ENSDF format) for current experimental nuclear structure publication. Scan the webpages of prominent journals in nuclear physics for new papers.	About 280 current publications were identified; 353 new datasets were compiled for XUNDL. 18 previous datasets in XUNDL database were updated for new papers.
Review compiled data sets submitted by other data centers prior to inclusion in the XUNDL database.	65 datasets from TUNL and 28 datasets from ANL were reviewed prior to entry in XUNDL database.
Communicate with the authors of the original papers for data-related problems and to request additional details of unpublished data.	Communications continued with the authors during the year with about 60 or so e-mail exchanges.
Train a new undergraduate student in 2013 for XUNDL and other compilation work.	Elaine McNeice, an undergraduate student at McMaster was trained for XUNDL compilations
Unplanned activity	Participated in XUNDL-working group meeting at TUNL May 16-17, 2013; one presentation and discussion about future of XUNDL activity.

TUNL Planned Activities	Status
Compile XUNDL data for A=2-20	We have compiled 65 XUNDL data sets for the FY2013.

C. Data Evaluation for ENSDF

The 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. The US effort is supplemented by foreign contributions prepared under the auspices of the IAEA-sponsored international Nuclear Structure and Decay Data network.

ANL Planned Activities	Status
Evaluate at least 1 mass chain from the ANL region of responsibility.	2 mass chains (A=112 and 209) were evaluated.
Review mass chain evaluations, as requested.	1 mass chain was reviewed.
Collaborate with scientists from other NSDD network centers on data evaluation projects.	Collaborated with S. Lalkovski (Sofia), T. Kibedi (ANU), G. Audi (Orsay) and M. Wang (IMP).

BNL Planned Activities	Status
At least 4 mass chains, or their equivalent nuclides, will be evaluated.	7 Mass chains were evaluated.
At least 4 mass chains, or their equilanent nuclides, will be reviewed.	6 mass chains were reviewed.
Continue mentoring new ENSDF evaluators.	Lectured and hands-on training to Indian scientists at a training workshop at Kolkata, India

LBNL Planned Activities	Status
Evaluate the equivalent of at least 2 mass chains, 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.	3 mass chains are evaluated (submitted) 21,28,171 (FY13) and 2 nuclides were updated 167Ta and 186Po.

Review mass-chain evaluations, as requested.	Continuing.
Work with the NNDC to include DDEP decay data and EGAF capture gamma-ray data in the ENSDF file and published in Nuclear Data Sheets.	Decay and EGAF data are published in PRC and also compiled for XUNDL.
Move Isotope Project activities to the UC Berkeley Department of Nuclear Engineering, hire an additional nuclear data evaluator, and begin a search for new senior evaluation personnel to replace retiring group members.	Move of Isotopes Project activities to UCB discontinued. Efforts have been devoted for training evaluators/compilers for ENSDF/XUNDL databases for possible future hires.
Collaborate with LLNL to develop a new XML format for the ENSDF file.	Activity did not take place.

McMaster Planned Activities	Status
2 equivalent mass chains and the data for new nuclides as mentioned below) will be evaluated.	A=86 and 215 were submitted, together with evaluations of 86 (mainly new) individual nuclides for ENSDF: total of 111 nuclides.
Mass chains will be reviewed as requested.	One full-length mass chain was reviewed.
Update ENSDF for the identification of new nuclides and for the first publications on the findings of the excited states of nuclides.	As stated in item 1 above, 86, mostly new, nuclides were evaluated for ENSDF
Prepare final versions of the mass chains currently in the pipeline	A=31, 75 and 89 were finalized and published in NDS. 5. A=211 evaluation done as part of IAEA-ICTP ENSDF workshop , coordinated by B. Singh . This work is now published.

ORNL Planned Activities	Status
Complete evaluation of structure information for nuclei in the A=241-249 region: A = 243 and A=244 are anticipated.	A = 243 submitted, A=54 reviewed, A=69 reviewed.

TUNL Planned Activities	Status
Prepare the ENSDF files corresponding to new publications in the "Energy Levels of Light Nuclei" series.	The ENSDF file for A=3, corresponding to our previous publication, is in preparation. The ENSDF file for A=12, corresponding to a planned publication, is being prepared simultaneously with the Energy Levels of Light Nuclei review. Our post-doc intends to publish a review of A=2 nuclides in Nuclear Data Sheets.
Prepare data sets for beta-delayed particle emission reactions.	Submitted 10 data sets for beta decay and beta-delayed particle emission reactions.

D. Ground and Metastable State Properties

The NNDC maintains a database of nuclide properties for the Nuclear Wallet Cards.

BNL Planned Activities	Status
Update database as new information becomes available.	Updates done regularly.

E. Non-ENSDF Decay Data Evaluations

ANL: compile and evaluate radioactive decay data for selected nuclei that are of relevance to nuclear structure physics and astrophysics, as well as to energy and non-energy (medical radioisotopes) related applications.

ANL Planned Activities	Status
Evaluate at least one radionuclide for the DDEP collaboration.	Activity terminated.
Review of selected nuclides for the DDEP collaboration, as requested.	Activity terminated.

McMaster Planned Activities	Status
Evaluate or review decay datasets for one or two radionuclides, as needed.	Participated in biennial DDEP meeting Oct 8-10, 2012 in Paris. Presented two invited talks.

F. Neutron-Induced γ-Ray Data Evaluation

The EGAF (Evaluated Gamma-ray Activation File) database, disseminated by the IAEA and maintained by LBNL, currently provides discrete-line prompt γ-ray information from thermal (n,γ) reactions in a format tailored to suit the needs of the neutron activation analysis community. However, it requires ongoing maintenance and development to make it more useful to the applied communities it serves. Statistical-model calculations can generate quasi-continuum photon cascade data to complement these experimental discrete-line data. Together, the experimental and calculated data could constitute a valuable resource required for updating the ENDF database. Additionally, delayed photon data need to be added to EGAF. The k0-value database currently used by the neutron activation analysis community needs to be assessed and compared with the corresponding decay information in ENSDF, and the resulting evaluated k0 values then need to be integrated into EGAF and, ultimately, made available to ENSDF evaluators.

LBNL Planned Activities	Status

Continue to maintain and update the EGAF database in collaboration with the IAEA and LLNL.	Work performed – mentioned above.
Collaborate with LLNL to perform statistical-model calculations of quasi-continuum gamma-ray cascade information and generate ENDF-format capture gamma-ray datasets for use with MCNP and other transport-code calculations.	Collaborated with LLNL for tungsten and europium isotopes.
Provide improved nuclear stucture data for the RIPL library from the EGAF evaluations.	Same as mentioned above.

LLNL Planned Activities	Status
Evaluation of EGAF data in collaboration with LBNL	Continue to collaborate with LBNL for evaluation of EGAF data using NA-22 funding.

G. Evaluation of Light Nuclei for Nuclear Physics A.

TUNL evaluates additional data not included in ENSDF for publication in Nuclear Physics A and on its web site.

TUNL Planned Activities	Status
Finalize publications in the A=12 and 13 region.	Preparation of the A=12 review is our main emphasis; a preprint is expected in late 2014, with a publication sometime in 2015. Activities in review of A=13 nuclides have resulted in about 30% of the review being completed, but this effort is presently on hold.

H. Nuclear Structure Data Measurement

ANL - ANL will devote a relatively small effort (0.1 FTE) to participate through collaborative agreements in nuclear physics research activities related to nuclear data needs. The emphasis will be on data measurements aimed at providing answers to specific questions that arise from recent nuclear data evaluations and at improving the quality of existing databases in specific areas, such as (but not limited to) decay data of minor actinides and neutron-rich fission products. Maintain important collaborative connections with RIA and GRETINA research communities, because of their vital importance to the nuclear science in US.

ANL Planned Activities	Status
Participate in nuclear physics research activities at ANL and other major nuclear physics facilities with main emphasis on decay studies of neutron-rich fission products, spectroscopy of heavy actinide nuclei and nuclei far from stability line.	Participated in a number of research activities at ANL (ATLAS and CARIBU) and MSU. Some of the results have already been published.
Complete analyses of 179Tl and 180Tl decay data and publish the results.	Results on 180Tl were published, while those on 179Tl are in preparation for publication.

LANL: LANL/LANSCE continues to maintain a small program to measure nuclear decay data information.

LANL Planned Activities	Status
Examine prompt gamma-ray emission data and gamma-gamma coincidence data from neutron reactions on nickel isotopes to search for previously unobserved transitions in these nuclides.	The data have been analyzed and no new transitions were found. The excitation functions were analyzed for ^{60}Ni(n,xpyn) reactions to states in ^{56}Fe.
Interact with mass chain evaluators on the nuclear structure of these nuclei.	No particular interactions in FY2013.
Search for isomers following neutron-induced reactions at GEANIE and DANCE.	Milli-second isomers were found at GEANIE in ^{114m}In, ^{205m}Pb, ^{75m}As, ^{71m}Ge, ^{171m}Yb, ^{208m}Bi, and ^{206m}Bi.

LBNL – to promote a closer working relationship with the nuclear structure community, LBNL will devote a small effort (~0.1 FTE) to participation in local nuclear structure experimental work.

LBNL Planned Activities	Status
Develop a high intensity D+D,D+T neutron generator facility in collaboration with the UC Berkeley Department of Nuclear Engineering, LLNL, and the Berkeley Geochronology Department. Perform neutron cross section and capture gamma ray measurements with 0-14 MeV neutrons.	Provided lead support in the installation of the D+D neutron generator at UCB NE building. Test run of the neutron generator will be conducted soon.
Continue capture gamma-ray cross section measurements with neutron beams at the Budapest and Garching FRM II Reactors.	Measurements of 193Nb and 238U isotopes were done at Budapest Nuclear Research Reactor.
Perform DICEBOX statistical model calculations to determine total radiative cross sections and nuclear level spins and parities.	DICEBOX simulations are in progress for several isotopes – through students' participation.
Publish new research on the Younger Dryas impact event, discovered by the LBNL Isotopes Project, that caused 1300 years of global cooling and the extinction of the Mammoths and megafauna.	Published two replies in PNAS 110, E3897 and E3900, 2013 by R.B. Firestone (retired).

Publish the discovery of 22 supernovae that exploded <250 pc from Earth during the past 300 kyr. This analysis based on the radiocarbon record is the first complete observation of cosmic rays emitted from an SNR.	Work continue on personal interest (R.B. Firestone).

I. ENSDF Physics and Checking Codes

The NNDC maintains ENSDF checking and physics programs on behalf of the national and international evaluator networks

ANL Planned Activities	Status
Port and test the main ENSDF analysis codes to Mac X OS in collaboration with other NSDD centers.	In collaboration with the ANU center, the main ensdf codes were ported to Mac OS X and rigorously tested.

BNL Planned Activities	Status
Maintain and upgrade ENSDF checking and physics programs for format changes as required.	Added a bug fix for fmtchk, and started process of conversion to gfortran.

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. Incident neutron reactions have been well covered historically. NNDC thus concentrates on new measurements, but continues compilations of earlier publications that have not been included in the CSISRS database. Since incident charged particle data have not been completely compiled in the past, NNDC is compiling new charged-particle measurements. In addition, because of emerging needs such as astrophysics, the NNDC is compiling older data. Hence, there is a larger staff commitment to compiling this type of data.

BNL Planned Activities	Status
Compile experimental data for neutron, charged particle, and photon induced reactions from about 110 publications.	Experimental nuclear reaction data from 147 new publications were compiled. 54 existing entries were modified.

B. ENDF Evaluations

Evaluated nuclear reaction data, for applications and for 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 insure 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 for ENDF/B-VII released in FY2007. LLNL develops a computer code that translates LLNL evaluations in the internal ENDL format into ENDF-6 formatted data so that LLNL evaluations can flow back into the nuclear data community.

BNL Planned Activities	Status
Respond to user needs for evaluated nuclear reaction data.	The NNDC is working with KAPL to improve the Zr evaluations in the ENDF library in response to KAPL dat testing.
Collect and address users feedback related to the ENDF library.	Users feedback related to the ENDF library was collected and posted in the form of trackers on the GForge server.
Work with members of CSEWG to upgrade evaluations for future release of the ENDF/B library (version VII.2).	Corrections from the ENDF community have been made to several evaluations and integrated into the development version of the library. New evaluations have also been integrated into this version.
Improve methodology for providing covariance data in the resonance region and in the fast neutron region to the next release of ENDF.	Assimilation methodology has been continuously developed to improve covariance capabilities in the fast neutron range. The work in the resonance range has been put on hold awaiting for the results of the WPEC subgroup mandated to develop realistic covariance methodology in the resonance region.
If the proposed Generalized Nuclear Data (GND) format is approved by CSEWG, begin releasing ENDF libraries in the GND format.	WPEC Subgroup 38 was formed to develop a hierarchical nuclear data format to succeed the ENDF format. This format will build on the significant experience gained with the GND prototype format. NNDC is playing a major role in the development of this successor format. CSEWG has determined that the next major ENDF release will be in both the new format and in the legacy ENDF format.
Integrate processing and validation codes into the ENDF continuous integration system so that evaluators can have instant quality feedback on their submitted evaluations.	The NNDC has developed the ADVANCE continuous integration system which uses NJOY, Fudge, PREPRO and the NNDC checking codes to check every ENDF evaluation as they is submitted to the NNDC.
Improve calculations of decay heat and anti-neutrino spectra following the fission of actinides nuclides.	See item VI.I below

LANL Planned Activities	Status
Upgrade the LANL ENDF evaluations for actinides that perform well in criticality benchmarks, considering new LANSCE experimental data.	The evaluation of ^{233}U upgraded. ^{238}Pu, ^{240}Pu, and ^{241}Am evaluations finalized.

Provide upgraded ENDF evaluated data files for light elements, including covariance data.	New evaluations of ^{9}Be capture cross section performed. The ^{16}O capture cross section was also upgraded. Both evaluations include the covariance data.
Provide new evaluations of prompt fission neutron spectrum for major actinides based on improved modeling at LANL.	New fission prompt fission neutron spectrum data for ^{235}U, ^{239}Pu, and ^{252}Cf produced based on the Monte Carlo technique.
Provide new evaluations for major actinides when the target is in its excited state.	Modeling for the nuclear reactions when the target is in its excited state developed. A new evaluation of ^{236}Np metastable state submitted for the new ENDF.

LLNL Planned Activities	Status
Perform new evaluations as per LLNL customer requests and submit these and other LLNL generated evaluations into ENDF.	No new evaluations produced in ENDF format due to budget constraints.

C. ENDF Manuals and Documentation

The NNDC is responsible for maintaining the format and procedures manual for the ENDF system. We also produce the documentation supporting the contents of the ENDF/B library.

BNL Planned Activities	Status
Maintain ENDF-6 formats manual up-to-date with CSEWG endorsed format changes. This format is used for the ENDF/B-VII library. Updates are now being managed using a Subversion repository on NNDC's GForge server.	Several format revisions were approved at the November 2012 CSEWG meeting and have been integrated into the ENDF manual.

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. Maintaining accurate current values for the standard cross sections is the primary objective of this task that can be most efficiently accomplished through international cooperation. A new international evaluation of the neutron cross-section standards is now underway. It is important to improve the standards database and procedures for evaluations in preparation for new evaluations of the standards. To assist in this, an IAEA data development project "maintenance of the neutron cross section standards" was initiated to ensure that we are prepared for the next evaluations of the neutron cross section standards. Historically the standards evaluation activity has included data other than the cross section standards, i.e. the thermal constants and the ^{252}Cf spontaneous fission neutron spectrum. Recently the scope has been broadened, largely through the data development project, to include an investigation of possible inelastic scattering cross section reference standards; considering adding additional standards energy ranges for the Au(n,γ) cross section; and proposing updates for the evaluations of the ^{252}Cf spontaneous fission neutron spectrum and the ^{235}U thermal neutron-induced fission neutron spectrum.

LANL Planned Activities	Status
Participate in the international effort to reevaluate the light-element standard cross sections with LANL leadership for H, Li and B, and investigate the nature of output covariance data from R-matrix analyses of systems containing the light-element standard cross sections.	Two LANL scientists and a post-doc attended the IAEA meeting on the standards evaluation. LANL takes leadership for new evaluations of hydrogen, carbon and oxygen.
Incorporate the cross section standards into the new ENDF evaluations, and perform validation tests with integral measurements.	There was no new evaluation that incorporated the standards during this fiscal year.
Complete report on the measured cross sections for the standards reaction ^{6}Li(n,alpha) in the MeV region together with an R-matrix analysis of these and literature data. The measured data have already been given to the NNDC.	R-matrix analysis is in progress. The measured data have already been given to the NNDC. Report not yet completed.
Continue experiments on H(n,n) angular distribution for improving the standard at several neutron energies for forward neutron scattering angles in the center-of-mass. This measurement follows the H(n,p) measurements that improved the data base at backward angles. We collaborate with researchers at Ohio University and NIST.	Symmetric source reactions such as D+D -> n + ^{3}He, ^{6}Li+^{6}Li -> ^{11}C + n, were tested. For these symmetric reactions, the neutron yield in the center of mass is the same for supplementary angles and therefore can be used to give the relative response (sometimes called the "efficiency") of neutron detectors at two different neutron energies in the laboratory. The cleanest reaction was found to be D+D.
Continue measurements and analysis of data taken at GEANIE to identify and quantify neutron-induced gamma-ray production cross sections that could be used as reference cross sections against which other measurements could be normalized.	This activity is continuing. We participate with European laboratories in this research in meetings sponsored by the IAEA.

NIST Planned Activities	Status
Continue work on the IAEA data development project on maintenance of the neutron cross section standards. Prepare for the next IAEA Consultants' Meeting on this project and provide results on the updating of the standards database and its impact on the standards.	Prepared for the IAEA meeting, attended it, gave a presentation on the status of the data development project. Also chaired the sessions at the meeting. It was held on July 8-12 in Vienna. The plan for producing the next set of standards was developed at this meeting. All data must be in the files by December of 2014.
Prepare a paper for the ND2013 conference on the standards.	Attended the ND2013 conference and gave a paper on standards.

Work on the Program Committee for the 15th International Symposium on Reactor Dosimetry to be held in 2014.	Worked with the members of the Program Committee to determine what papers to include in the meeting
Continue work on an experiment using neutron detection (instead of proton detection) to measure the H(n,n) angular distribution in collaboration with Ohio University and LANL. Investigate uncertainties possible with the use of a time projection chamber for hydrogen angular distribution measurements.	Work continues on this project. It has been slowed down due to problems at the Ohio University facility (major changes in the accelerator to have a Pelletron charging system, changes in the safety system and loss of one of the staff). Regular conference calls are maintained to determine the progress. The focus now is on methods to determine the detector efficiency for the system used to measure the hydrogen scattering cross section. A simulation is being designed to determine the accuracy possible in the experiment. TPC work has been terminated. This work is done in collaboration with Ohio University, LANL and the U. of Guelma.
Continue work based on ^{252}Cf nu-bar leading to an improved calibration of NBS-I, the U.S. national primary standard neutron source and determination of our bath efficiency.	Work continues on this determination. Our work has led to uncertainties less than 1% but larger than the limiting uncertainty of this technique, the uncertainty in nu-bar for ^{252}Cf, 0.12%. There are still improvements that can be made to reduce the fluence uncertainty somewhat.
Complete the analysis of a measurement of the ^{6}Li(n,t) standard cross section at ~ 4 meV neutron energy using an improved fluence determination based on alpha-gamma coincidences with the ^{10}B(n,alpha) reaction. Continue work to finalize the design for the ^{3}H target for the n-^{3}H coherent scattering length measurement including safety review, detailed design, prototype fabrication, and element testing. This work complements work on the ^{3}He(n,p) standard cross section	The measurements of the ^{6}Li(n,t) cross section at ~ 4 meV have been completed. The analysis is complete and work on a publication is underway. Work continues on the n-3H coherent scattering length measurement. A significant problem is the safety review since working with tritium at the reactor facility will be necessary.
Continue the documentation of changes to EXFOR files based on the corrections obtained from the files of Poenitz and new information obtained from the CRP investigations.	Work on this project has progressed slowly due to other work on the standards program having higher priority.
Continue to recommend and encourage new measurements and perform examinations of the data from them for use in future evaluations of the standards.	A significant number of new measurements are being added to the standards database. Each experiment requires examination. This must all be completed before the new standards evaluation can begin.
Continue to acquire and monitor samples in the National Repository for Fissionable Isotope Mass Standards. Also make these samples available for loan in physics experiments.	Samples in the National Repository have been monitored to ensure their quality. These samples ar available for loan in nuclear data applications.
Work on the Program Committee for the ND2013 conference. Contribute to a session on 75 years with nuclear fission	Worked on the Program Committee for the ND2013 conference as a session Chairman at the meeting. Prepared a presentation for the 75 Years with Nuclear Fission meeting in Washington, DC.

E. Nuclear Model Development

This task covers activities such as development and validation of nuclear reaction models used for prediction of nuclear reaction cross sections. The two major codes are GNASH (LANL) and EMPIRE (BNL). Measurements made by ANL and LANL 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. BNL and LANL will also participate in the IAEA Coordinated Research Project RIPL-3 to improve accuracy and reliability of input parameters used in nuclear reaction calculations

BNL - We are active in nuclear reaction model development focusing on the BNL code EMPIRE. The work in this fiscal year will concentrate on further extensions and improvements of its capabilities, including a new version of the level densities with appropriate parameterization. The work on validation of the code will be actively pursued, in particular in relation to emerging requirements of homeland security applications. Close collaboration with LANL will continue focusing on validation of the fission models in EMPIRE and GNASH. Major effort is dedicated to the development of capabilities for estimating covariance data for fast-neutron reaction cross sections. In response to the needs from many user groups (such as Gen-IV reactors, criticality safety, Advanced Fuel Cycle Initiative), BNL will collaborate with LANL and ANL on a methodology for nuclear data covariances. To this end, a covariance module in EMPIRE for fast neutron energies should be extended and tested.

BNL Planned Activities	Status
Release new version of the code EMPIRE with above-mentioned improvements.	New versions of the EMPIRE code were available from the NNDC GForge server including: • Simulation of the Engelbrecht-Weidenmuller transformation. Change in inelastic compensated by changing the compound elastic • Including gamma and fission transmission coefficients calculated by EMPIRE into ECIS compound calculation • Kalbach parameterizations for breakup and transfer reactions of complex projectiles • MLBW approach added to the resonance module • Nobre's deformation systematics
Maintain GForge site with the current version of the EMPIRE code.	GForge server was maintained. 358 changes were committed to the Subversion system since Nov. 1, 2012 through the date of the CSEWG 2013 meeting.
Advance integration of the particular features need for the data assimilation.	- Improved support for assimilation procedure - Improved qsubEmpire.py for running on cluster - Add tab in Xrun.tcl that applies Kalman results back to Empire input file.
Expand testing framework to improve the EMPIRE development cycle.	Integration of EMPIRE with the ADVANCE system for continuing QA has been pursued throughout the year, within technical possibilities being

	available.

LANL - Nuclear reaction theory calculations have played a crucial role in the evaluation of nuclear data, and will continue to play an important part in future evaluations. The LANL GNASH code has proved to be an important tool, and we will continue development of advanced model codes to provide a state-of-the-art capability to predict reaction cross sections and to explore nuclear reaction physics in detail. This also involves a close collaboration with experimentalists at LANSCE to interpret new measurements using the GEANIE, DANCE, and CHI-NU detectors. These data will result in advances in our understanding of nuclear reaction mechanisms, and improvements in our modeling codes.

LANL Planned Activities	Status
Develop a code to calculate the prompt neutron and gamma spectra from fission fragments, using the Monte Carlo technique for the Hauser-Feshbach statistical decay, and apply this to prompt fission neutron spectrum evaluation.	The Monte Carlo simulation code for calculating neutron and gamma-ray correlations applied to the prompt fission neutron and gamma-ray spectrum calculations. Two Phys. Rev. C papers and one Nucl. Phys. A paper were published on this subject.
Apply a coupled-channels Hauser-Feshbach method to neutron capture process for deformed targets to study gamma-ray cascading, in support of DANCE and GEANIE measurements.	The coupled-channels Hauser-Feshbach method applied to neutron capture process for deformed nuclei, such as neon. A Phys. Rev. C paper published.
Study ^{238}U and ^{239}Pu neutron elastic and inelastic scattering at low-excitation energies where the evaluated nuclear data libraries are discrepant.	Study on inelastic scattering at low-excitation energies continues. A paper submitted to J. Nucl. Sci. Technology in collaboration with BNL.
Develop a microscopic description of fission process in the fast energy range, which includes Class-I and Class-II coupling. Apply this method to major actinides, such as ^{239}Pu, to validate this new fission theory	New microscopic fission model developed, which includes Class-I and Class-II state coupling. The method was applied to the major actinides, and a Phys. Rev. C paper published.
Study excitation energy sharing between two fragments at fission, which is important for calculating prompt fission neutron spectrum.	Several models for the excitation energy sharing mechanism developed, and applied to the fission neutron spectrum calculations.

LLNL Planned Activities	Status
Event by event fission modeling with FREYA	We have refined the treatment of angular momentum in FREYA to include fission of a nucleus with initial orbital angular momentum as well as treatment of angular momentum fluctuations via the bending and wriggling modes, this incorporating explicit angular momentum conservation. We have studied the influence of these effects on observables and have also looked for additional novel observables of this physics. This paper has been published by Physical Review C. We have work with experimentalists on other analyses. In addition, with the assistance from Jerome Verbeke, FREYA-1.0 (released under BSD license) is being incorporated into the MCNP6, TRIPOLI-4.9, and Geant4 transport codes as part of the LLNL fission library.

F. Nuclear Reaction Data Measurements

The measurement of nuclear data is essential to provide data, which either cannot be calculated or cannot be calculated with sufficient accuracy for user applications. This activity is also essential to support and verify nuclear model development and application.

ANL: ANL has recently initiated a new program in collaboration with INL (Measurement of Actinide Neutronic Transmutation Rates with Accelerator mass spectroscopy - MANTRA), supported through ARRA funding from ONP/DOE, aimed at obtaining valuable integral information about practically all high mass actinides neutron cross sections that are of importance to advanced nuclear fuel cycles and to USNDP.

ANL Planned Activities	Status
Coordinate research activities between INL and ANL and participate in nuclear data measurements, equipment development, cross section modeling and sensitivity studies.	Coordinated collaboration meetings and participated at research activities at ANL.

LANL Planned Activities	Status
Analyze neutron inelastic scattering made with the GEANIE and FIGARO arrays. Correlate new data from GEANIE with data from FIGARO on targets of ^{56}Fe and ^{58}Ni. New measurements at GEANIE will include ^{60}Ni.	The measurements at GEANIE for ^{60}Ni have been completed and cross sections were obtained. Data for the other two isotopes are being analyzed.
Continue to improve the techniques to measure the fission-neutron spectrum for fission induced by neutrons of 0.4 to 200 MeV on ^{235}U and ^{239}Pu. The shape of the major part of the emission spectrum between 0.1 and 10 MeV will be determined in this experiment, performed in collaboration with LLNL and CEA researchers, and will be compared with the Los Alamos model prediction. The modeling includes the Monte Carlo prompt neutron emission technique and the microscopic quantum mechanical pre-equilibrium calculations. In FY13, we will complete measurements on the portion of the fission neutron spectrum below 1 MeV for ^{235}U or ^{239}Pu.	The measurements with the FIGARO array have all been analyzed and published. These data extend from slightly below 1 MeV up to approximately 10 MeV for the fission neutrons. A new array of neutron detectors, called "Chi-Nu", has been commissioned and used with ^{6}Li-glass detectors to measure fission neutrons below 1 MeV.

Complete analysis of data on ^{173}Lu(n,gamma) at DANCE for studying level densities on ^{174}Lu through the capture resonances on radioactive ^{173}Lu nucleus.	The data have been analyzed and reported by coworkers at the French CEA laboratory at Bruyeres-le-Chatel.
Complete data analysis for gamma-ray output from neutron-induced fission of ^{235}U and ^{239}Pu and spontaneous fission of ^{252}Cf. Collaborators include scientists from LLNL.	The data taken at DANCE for fission of ^{235}U, ^{239}Pu, and ^{252}Cf have been published.
Measure neutron capture cross sections ^{239}Pu and ^{241}Pu for neutron energies less than 200 keV, contingent on obtaining the targets. Measure ^{239}Pu capture-to-fission ratio.	The neutron capture cross section for ^{239}Pu for neutrons up to 1 keV has been published. Data up to 100 keV have been taken and are being analyzed. The capture-fission ratio was obtained.
Measure the neutron capture cross-section at DANCE for at least one radioactive isotope of importance to nuclear astrophysics.	The neutron capture cross section of ^{63}Ni was measured. The thesis describing the measurements and results is nearly finished.
Develop the Time-Projection Chamber for accurate fission cross section measurements.	The TPC was developed and is now in used for fission cross section measurements.
Analyze data for the ^{237}U(n,f) cross section taken at the LANSCE Lead Slowing-Down Spectrometer.	The analysis requires an accurate neutronics model of the LSDS, and this is being developed.

LBNL: – LBNL has recently initiated a new program to use surrogate reactions to deduce reaction cross sections which are of importance to Advanced Fuel Cycle (AFC) programmatic needs (a national priority). This is collaboration between the nuclear structure and nuclear reaction groups at LBNL and outside groups at LLNL and the University of Richmond that is currently funded from outside of the DOE Data Program. The LBNL group is leading a series of benchmarking experiments to test the applicability and accuracy of these new techniques for deducing cross sections of importance to AFC and the s-process. It is anticipated that this activity will provide nuclear reaction data measurements of importance to the Data Program. LBNL is collaborating with the Budapest Reactor Centre in the measurement, using isotopically-enriched targets, of selected thermal (n,γ) cross section data to supplement earlier elemental target measurements from which important information was either lacking (e.g., data from low-abundance isotopes) or discrepant.

LBNL planned activities	Status
Measure thermal (n,g) gamma ray and total radiative cross sections using guided neutron beam in collaboration with the Budapest Research Centre and the Garching FRM II reactor.	(n,gamma) measurements carried out on 93Nb and 238U isotopes. Analysis in progress.
Lead series of surrogate-reaction benchmarking measurements at the LBNL 88" cyclotron.	Discontinued due to relocation of STAR-LIBERACE counting facility from 88-Inch Cyclotron, LBNL.

G. Evaluation of Data Needed for Astrophysics

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
ANL will continue working in the area of data needs for nuclear astrophysics. The main emphasis will be on improving the data for cosmo-chronometers in the rare-earth region - 176Lu, 180Ta and 186Re.	Work on 176Lu and 180Ta is completed, while that on 186Re is continuing.
Compile and evaluate nuclear structure and decay data for neutron-rich fission fragments, produced at the CARIBU facility (ANL), that are of relevance to r-process modeling.	Analysis on 142Cs data obtained with Gammasphere at CARIBU is in progress.

BNL Planned Activities	Status
Produce Maxwellian-average neutron capture cross sections and astrophysical reaction rates for entire s-process path.	Maxwellian-averaged cross sections, astrophysical reaction rates and their uncertainties have been produced using the major evaluated library data and European activation file.

LANL: Participate in the USNDP effort to develop high-quality data for astrophysics calculations of nucleosynthesis. Make new calculated and evaluated results available to the wider astrophysics research community via the USNDP Astrophysics Task Force.

LANL Planned Activities	Status
Improve neutron capture models to provide neutron capture rates off-stability to s and r-process hydro-dynamics simulations.	A global test of neutron capture rate calculation performed against evaluated Maxwellian averaged cross sections. Systematic behavior of average gamma-width and level density parameters investigated.
Continue working on beta-delayed fission rates in the astrophysical stellar environment, based on the macroscopic-microscopic nuclear mass model.	Beta-delayed fission modeling continues.
Study on nuclear reaction rate database currently used in the r-process calculations, and provide updated reaction rates if needed.	Deficiencies in the reaction rate database identified for I-137, and possible explanation was given. A Phys. Rev. C paper that include this issue submitted.

ORNL: Evaluate capture reactions on radioactive proton-rich nuclei which are important for element synthesis and energy generation in stellar

explosions.

ORNL Planned Activities	Status
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 ion beam facilities around the world.	A paper on the beta decay of fp-shell nucle important for rp-process burning in X-ray bursts was published, and the astrophysical implications of the new lifetimes were discussed. An assessment of levels in 27Si from a measurement of 26Al(d,p) at ORNL is almost complete, and a paper has been drafted. Thermonuclear reaction rates from the NACRE II rate collection have been fit with the tools in the Computational Infrastructure for Nuclear Astrophysics and put online so that the research community can utilize them in simulations of stellar explosions. A paper has also been drafted on the structure of exotic Neon isotopes, with a detailed examination of the data and its implication for the presence of a halo structure in 29Ne and 31Ne. Similar techniques will be utilized to examine the structure of a number of nuclei of importance to astrophysics.
Extract spectroscopic information (excitation energies, spectroscopic factors, spins, parities, ANCs) on nuclei near the N=82 closed shell – 127Sn, 129Sn, 131Sn, 133Sn, 135Te - from transfer reaction measurements on radioactive Sn and Te nuclei. This information is important for modeling the r-process in supernovae.	An ORNL analysis of the structure of the exotic nucleus 131Sn was published in PR. This paper also discussed the initial implications on the direct neutron capture cross section on 130Sn important in the astrophysical r-process that occurs in Supernovae. Two follow-up projects are in progress -- looking at systematic evolution of single particle levels in exotic Sn nuclei as a function of neutron number, and examining direct capture cross sections for a series of captures on exotic Sn nuclei. Papers are being drafted on both of these projects.

H. Covariances Development

Quantification of uncertainties and their correlations, mathematically represented as covariance matrices, became recently a focal point of the ENDF evaluation effort world-wide. A strong motivation for this revival is the role of covariances in guiding adjustment of the evaluations to the integral experiments to improve reliability and performance of the new libraries. Work in this field includes improvement of the methodology as well as development of actual covariance data. Major covariance activities are carried out at BNL, LANL and ORNL (the latter in the resonance region).

BNL Activities	Status
Work on COMMARA-3 library of covariances. COMMARA-3, a library of covariances for the major reaction channels processed on a 33-energy grid, will be based on the recent release of ENDF/B-VII.1. The library will be reviewed and additional covariances will be included for the 1st Legendre moment for elastic scattering (mubar), average number of neutrons produced/fission (nubar), prompt fission neutron spectra (PFNS), and cross-material, cross-reaction covariances, where applicable.	The first beta release of the COMMARA-3 library of reaction covariances was completed in fall 2013. As the COMMARA-2 library was based on the cross sections from ENDF/B-VII.0, COMMARA-3 is to be applied to reaction cross sections of ENDF/B-VII.1. The initial beta release of COMMARA-3 was to provide a baseline of the covariances contained in ENDF/B-VII.1, processed using the COMMARA 33-group structure with minimal adjustments. The only modifications allowed were those necessary to maintain the mathematically consistency of the library, such as the removal of negative eigenvalues that can arise from truncation, etc. This first beta version has been tested and shown to reduce integral uncertainties, but a number of important covariances which were not included in ENDF/B-VII.1 have not been added to COMMARA-3 due to loss of project funding.

I. Reactor antineutrino spectra and decay heat calculations

The NNDC has been setting up methos to calculate antineutrino spectra decay heat from fissioning systems using the fission yield and decay data sub-libraries from ENDF-6 formatted libraries.

BNL Activities	Status
Setup methods and databases to calculate anti-neutrino spectra for major actinides.	The beta intensities from TAGS experiments were added to a beta version of the ENDF decay data sublibrary. Additionally, the beta intensities from fitting the Tengblad results were also added. The antineutrino spectra calculations are more reliable as a result. We have also spend some time helping organize a workshop at the INT in Seattle.

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 National Nuclear Data Center. Furthermore, checking performance of the library against the integral experiments, known as validation, is an important step ensuring 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 Activities	Status
Establish automatic, real time verification and validation of the new/modified ENDF evaluations submitted to the NNDC GForge server.	Beta version of the ADVANCE continuous integration system using ControlTier as a distributed command execution framework now running on an NNDC machine.

Appendix A
Nuclear Data Activities Funded from Sources outside the Nuclear Data Program (Report FY2013)

ANL

Additional support for the nuclear data work at Argonne comes from three ARRA projects funded by the Office of Nuclear Physics, DOE-SC (ONP/SC) and one LDRD project funded by ANL:

1. ARRA funded project through ONP/SC entitled " Nuclear Data Program Initiative" provided partial support for a post-doc. This project will be completed at the end of FY2013.

2. ARRA funded project through ONP/SC entitled "Measurement and Evaluation of Actinide Neutron Cross Sections Relevant to Advanced Fuel Cycles via Accelerator Mass Spectroscopy" provided partial support for a post-doc. This project will be completed at the end FY2013.

3. ARRA funded project through ONP/SC entitled " Beta-decay Studies of Neutron-rich Fission Products for Advanced Fuel Cycle Applications" provided partial support for a post-doc. This project will be completed at the end of FY2013.

4. ANL LDRD project entitled "Development of a Close-Packed LaBr3(Ce) Detector Array for Nuclear Physics Applications" provided partial support for a post-doc. This project will be completed at the end FY2013.

BNL

Additional support for the nuclear data work at the National Nuclear Data Center comes from the US Nuclear Criticality Safety Program (NCSP), funded by DOE NNSA, which supports the NNDC services in maintaining NCSP data submitted to ENDF/B-VII library as well as data development work on estimates/evaluations of neutron cross section covariances for criticality safety applications.

LANL

Most of the nuclear data work is supported from funds other than the nuclear data program. The effort is in support of the ENDF-related work of nuclear model development, nuclear reaction evaluation and ENDF processing.

1. Advanced Simulation and Computing (ASC program). This work supports the development of more accurate ENDF cross section databases for actinide fission fuels, light-nucleus thermonuclear fuels, and for reactions on important materials used for diagnostics (radiochemical reactions). Nuclear model code development, for both statistical and preequilibrium models, and for light R-matrix codes, is supported by this program, as is the development of the NJOY data processing code for providing data usable by Monte Carlo and deterministic transport codes in applications. The funding also supports physics research developments in nuclear reaction and structure theory (with a recent emphasis on nuclei and isomers away from stability), and fission theory. Data testing using integral benchmarks such as fast critical assemblies is used to validate the ENDF data.

2. Nuclear criticality safety. This funding supports improved nuclear data important in criticality safety studies, such as uranium isotopes, as well as data on chlorine, aluminum, etc. Data testing using critical assemblies and NJOY processing code development is also funded by the program.

3.LANL LDRD. There are 2 LANL LDRD projects that support nuclear reaction data measurements and nuclear astrophysics r-process network calculation.

4. Nuclear Weapons supports LANSCE measurements of fission output (neutrons and gamma rays), neutron capture on actinides and radchem isotopes, and neutron reactions relevant to radchem.

LBNL

1. Supported installation of D+D neutron generator on the Berkeley campus. Additional funding has been requested from the Office of Science for cross section measurements.

2. A high intensity 8-33 MeV neutron beam facility has been constructed in collaboration with the LLNL NIF facility at the LBNL 88" cyclotron. Funding for this effort is supplied by LLNL and the LBNL low energy research program.

3. The Isotopes Project continues to mentor the LLNL nuclear data library effort, funded by NA-22.

LLNL

NNSA Defense Programs, the Department of Homeland Security, and branches of the Office of Science outside the USNDP support most of the nuclear efforts at LLNL. Funding from USNDP is used to coordinate these efforts and process data for use by the larger community. Much of the Livermore experimental work is made possible by beam time and collaborations at TUNL, TRIUMF, LBNL and LANSCE. Sponsorship for different nuclear efforts includes:

1. NNSA/ASC funds data evaluation, validation and verification efforts, development of theory supporting the surrogate measurement campaign for unstable actinides, and optical potentials. Also funds part of the nuclear data formats and the processing of nuclear data.

2. NNSA/DP/SC funds experimental campaigns for unstable actinides, including development of the Time Projection Chamber at LLNL for new 239Pu fission cross section measurements.

3. NNSA/NA-22 funds the event by event fission modeling and the capture-gamma-ray evaluations.

4. OS/ARRA funds in part the generalized nuclear data efforts in tandem with ASC/IC.

McMaster

No additional funding in FY-13

NIST

A variety of sources support nuclear data activities:

1. The Nuclear Data Verification and Standardization program has funding through the Commerce Department (NIST). This provides about half of the total support for the program.

2.NIST provides 1 FTE for standard cross section work using ~4 meV neutrons and also for interferometry work, which has yielded coherent scattering lengths (which provide scattering data) needed for neutron cross-section evaluations.

3.NSF provided 1 FTE for a graduate student to work on the interferometry experiments cited above.

4.NIST provided 1 FTE (75% experimental, 25% evaluation) for nuclear structure and decay data work. Much of this work also has applications in radioactivity standards and radiopharmaceutical studies.

ORNL

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

TUNL

The nuclear data work is partly funded by the DOE-SC Low Energy Nuclear Physics program through a TUNL/NCSU grant.