



Annual Report for FY2014

Prepared by:

Michal Herman

National Nuclear Data Center

Brookhaven National Laboratory

April 2015

With contributions from:

Shamsu Basunia, LBNL

Allan D. Carlson, NIST

Toshihiko Kawano, LANL

John Kelley, TUNL

Filip G. Kondev, ANL

Balraj Singh, BNL

Michael Smith, ORNL

Alejandro Sonzogni, BNL

Ian Thompson, LLNL

www.nndc.bnl.gov/usndp

Table of Contents

Summary of U.S. Nuclear Data Program activities for FY2014

I. Introduction

II. Network Coordination and Data Dissemination

III. Nuclear Structure and Decay Data

IV. Nuclear Reaction Data

V. Additional Accomplishments

USNDP Staffing table FY2014

Detailed status of the work plan for FY2014

I. NNDC Facility Operation

II. Coordination

III. Nuclear Physics Databases

IV. Information Dissemination

V. Nuclear Structure Physics

VI. Nuclear Reaction Physics

I. Introduction

The USNDP Annual Report for FY2014 summarizes the work of the U.S. Nuclear Data Program (USNDP) for the period of October 1, 2013 through September 30, 2014 with respect to the work plan for FY2014 that was prepared in February 2012. 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 33 FTE scientific, mostly at NNSA laboratories, to be compared with 21.6 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 2014 was the 15th 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 FY2014. Then, we continue with the detailed status of work done in FY2014. Total staff assigned to USNDP activities during the year represented 26.2 FTE.

Two major events happened this year, the NNDC moved from building 197D to building 817 in March and a DoE review of USNDP took place in July. NNDC staff had been preparing for the move for about two years, in particular, the library, that had accumulated material for over 60 years, took considerable amount of effort. Only material that is not available online was moved; still, the library contains publications not available anywhere else, which would cost about \$50 k to convert to electronic form. On a smaller scale, the NNDC servers and cluster were moved to BNL's ITD facilities in December 2014.

The USNDP review was the first one since the 1990's, presentations were made to a panel of 6 reviewers and DoE representatives. The review was positive and work has started in two assignments: the creation of an advisory board and the writing of a USNDP white paper.

In terms of personnel, the NNDC welcomed a new secretary, Letty Krejci, following the retirement of Yvette Malavet-Blum. Additionally, starting this fiscal year Balraj Singh will contribute 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. In particular, the FY2014 budget increased by 12.5%.

Table 1: Summary of the USNDP metrics in FY2001- FY2014, 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
2014	\$7,031K*	+12.5%	3,738	166	3,411	7	107	81

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

In particular:

- 1. Compilations.** Compilations efforts, including NSR, EXFOR and XUNDL databases, remain on the similar level.
- 2. Evaluations.** Evaluations efforts, the number of ENDF evaluations is on the low since no new releases of the library took place this year. The number of ENSDF evaluations is on the low side too, mainly due to a reduction of the FTE associated with this effort.
- 3. Dissemination.** This year there has remained constant. At BNL, the most popular product continues to be NuDat that contributes nearly 70% of data retrievals.
- 4. Reports.** The number of published reports has remained approximately constant over the last few 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.

Table 2: USNDP metrics in FY2014, numbers for FY2013 are shown for comparison.

Laboratory	Compilations		Evaluations		Dissemination (in thousands)		Reports		Papers		Invited Talks	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
ANL	28	8	28	0	40	40	0	0	25	26	5	5
BNL ¹	3,466	3,617	100	117	3,030	3,269	5	3	15	30	28	30
LANL	-	-	20	12	255	-	2	1	20	17	15	21
LBNL	4	30	36	15	-	-	8	0	3	8	2	6
LLNL	-	-	0	0	8	6	0	0	1	1	0	1
ORNL	-	30	8	16	40	88	0	0	11	9	13	7
Universities	1,427	53	90	6	76	107	14	1	9	12	15	1
Total	4,925	3,738	282	166	3,447	3,411	29	7	84	107	79	81

¹: BNL compilations for FY2014 consist of 3,130 NSR, 147 EXFOR and 340 XUNDL articles. BNL evaluations for FY2014 consist of 117 nuclides for ENSDF.

Definitions

- *Compilations*: The sum of the new entries added to the USNDP bibliographic (NSR - papers) and experimental databases (EXFOR - 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, 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 FY2014 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 2014, 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 2016 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 2013 CSEWG meeting was held at BNL. The major topic of the CSEWG meeting was the progress on the CIELO evaluations.

NNDC staff were involved in the organization of a workshop on the calculation of the spectra of antineutrinos emitted by nuclear reactors, which took place at the Institute for Nuclear Theory in November 2013.

USNDP Databases

The NNDC operates six 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 FY2014 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 FY2014, there were 3,411 million database retrievals, approximately equal to the number of retrieval in the previous year. Most of these retrievals, 95%, were from the NNDC web site, with NuDat as the most popular product.

Major Publications

USNDP continues to publish the refereed journal Nuclear Data Sheets dedicated predominantly to nuclear structure and decay data (ENSDF evaluations). The ND2013 proceedings were published in the April, May and June issues of Nuclear Data Sheets, totaling 344 articles. The January 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 1.3% over the past year. Presently there are 3259 nuclides reported. Along with many revised/updated datasets, two hundred thirty-seven new datasets were added to ENSDF, including 13 “Adopted Levels” datasets, 66 decay datasets and 138 reaction datasets. There were 15 mass chain evaluation articles published in the Nuclear Data Sheets. The number of “mass chains” in the review process was given as 31. An additional 37 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 5812 datasets covering 2271 nuclides from over 280 mass chains. A total of 448 new datasets from about 210 articles were added to the XUNDL database in the past year. McMaster University carried the bulk of the activity (318) with TUNL (53), LBNL+UCB (30), ORNL (37), ANL (8) and BNL (5). 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 14 current papers on mass measurements comprising data for about 65 data points (masses, pairs of mass differences, Q values, etc.); this information was contributed to ORNL's nuclearmasses.org webpage.

During the USNDP meeting, the XUNDL collaborators held a short session to discuss present and future effort commitments. Continued support of the activity was found in the group, with a new commitment from MSU. It is apparent that McMaster will continue to carry the majority of responsibility.

Status of the NSR: A total of 3130 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 on access to references through the IAEA/EXFOR online library.

Horizontal Evaluations and Other Data Related Activities: A summary list of “Horizontal Evaluations and Other Data Related Activities” involving USNDP structure evaluators follows.

- IAEA Technical meeting on ENSDF codes: Kondev, Singh, Tuli, Johnson
- 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, A.A. Sonzogni.
- 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,
- K Isomers in Deformed Nuclei with $A > 100$: F. Kondev
- AME and NUBASE: F. Kondev,
- Nuclear Structure Insights on Reactor Antineutrino Spectrum: A.A. Sonzogni, E.A. McCutchan, T.D. Johnson,
- Analysis of Nuclear Physics Authorship Trends: B. Pritychenko,
- Study of deep inelastic reactions, T.D. Johnson, E.A. McCutchan, A.A. Sonzogni,
- nucastrodata.org and the Computational Infrastructure for Nuclear Astrophysics (CINA): M. Smith,
- Collaboration with BLIP on the measurement of decay properties for a few radionuclides: E.A. McCutchan.

Other Business and discussion

A pressing issue connected with changes in the preparation of print-ready manuscripts for review and publication in the Nuclear Data Sheets motivated significant discussion at the USNDP meeting. Due to shrinking resources and a retirement at NNDC, the ENSDF evaluators are expected to play a greater role in preparation of the print-ready manuscripts. As detailed in Jag Tuli's 9-11/2014 e-mail, tools permitting an evaluator to control the .pdf output generated while processing the ENSDF files are in development.

Status of ENSDF Analysis codes: In recent years there has been extended discussion on the present state of ENSDF analysis codes. Several codes are known to have “bugs, which are in need of repair. In addition, there is presently a desire from several within the network to have development of codes that function on a broader variety of OS platforms. In the discussions, it was emphasized that NNDC is responsible for maintaining the present codes that are available from the NNDC website. The issue of moving forward with development of new equivalent applications having broader flexibility is the subject of a recent IAEA working group that met over the summer.

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 evaluated nuclear data library ENDF/B-VII.1, which is our latest evaluated nuclear data file recommended for use in nuclear science and technology applications, was released in December 2011. Our most important focus is to upgrade the library toward ENDF/B-VII.2 or ENDF/B-VIII in near future by including 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). International cooperative efforts are also indispensable to maintain the nuclear data libraries at high quality.

BNL explored angular distributions of neutron elastic scattering both in the resolved and unresolved resonance regions. Internal calculation of the scattering angular distribution for the Hauser-Feshbach theory was implemented in EMPIRE for consistent calculations with the evaluated cross sections.

New neutron capture data for ^{238}U measured at LANSCE with the DANCE detector were published. The new data showed a significant contribution of the M1 photon strength to the capture cross section. The data were also submitted to IAEA for upgrading the Standards.

BNL and LANL have been working closely on the new international effort on the evaluated nuclear data library, called CIELO (Collaborative International Evaluated Library Organisation), organized under the Working Party on International Nuclear Data Evaluation Co-operation (WPEC) at the Nuclear Energy Agency. New theoretical model calculations that include improved neutron scattering modeling were performed for iron and actinides to upgrade the CIELO files.

Model Code Highlights

EMPIRE-3.2 (Malta) includes improvements of internal calculation of angular distribution for the compound reaction, and non-linear fitting and covariance package based on CERLIB. A Windows-version EMPIRE became available. For quality assurance, EMPIRE is managed under the ADVANCE system, which runs benchmark tests and compares the results with a stable version automatically.

LANL upgraded CoH3 significantly by including nuclear mean-field theories to unify the nuclear structure and reaction calculations. Nuclear deformation effects on the inelastic scattering and neutron capture calculations can be considered consistently in the current version.

The FREYA code at LLNL focuses on observables such as neutron correlations and photons. The neutron observables include the neutron multiplicity distributions as well as that as a function of fission fragment mass, and angular correlations between two neutron or neutron and fission fragment. Incorporation of FREYA into MCNP6 is in progress.

Nuclear Astrophysics highlights

The standard JINA REACLIB database of thermonuclear reactions was extended to higher masses and more exotic nuclei to enable calculations of element creation in the rapid neutron capture process (r-process) in supernovae. This library is now a resource for the community. This work was followed by enabling r-process calculations to be carried out by researchers around the world the ORNL online Computational Infrastructure for Nuclear Astrophysics. Theoretical calculations with USNDP data as reference were made of the halo structure of $^{27-31}\text{Ne}$ that call into question recent suggestions that ^{29}Ne is a halo nucleus; a paper on this was published. A similar approach will be pursued for nuclei of astrophysical importance. Thermonuclear reaction rates published in two recent studies were fit to a parameterization that allows their utilization in astrophysics calculations by the broader research community; a paper on this is in progress. Cross sections of neutron capture on exotic Sn isotopes were made based on recent (d,p) transfer reaction measurements at ORNL and on nuclear structure information in USNDP data bases.

USNDP Staffing table FY2014

	ANL		BNL			LANL		LBNL		LLNL		NIST		ORNL				TUNL			Sum
	PhD P	PhD T	PhD P	PhD T	T/A	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	T/A	GS	PhD P	PhD T	T/A	
I. NNDC Facility Operation Management			0.60		1.70																2.30
Secretarial/Administrative Support			0.60																		0.60
Library					1.05																1.05
Computer Operations					0.15																0.15
II. Coordination	0.10		1.45	0.10		0.25				0.26				0.05				0.05			2.26
National Coordination			0.54	0.10		0.05				0.20				0.05				0.05			0.99
International Coordination	0.10		0.91			0.20				0.06											1.27
III. Nuclear Physics Databases			0.78		0.80					0.12											1.70
Nuclear Science References, NSR			0.20		0.70																0.90
Exper. Nucl. Structure Data, XUNDL			0.10																		0.10
Eval. Nucl. Structure Data, ENSDF			0.20																		0.20
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			0.08																		0.08
Database Software Maintenance			0.10		0.10																0.20
Future Database System Develop.										0.12											0.12
IV. Information Dissemination			1.02		1.00									0.10		0.25				0.50	2.87
Nuclear Data Sheets			0.30		0.75																1.05
Customer Services			0.10		0.15																0.25
Web Maintenance & Development			0.62		0.10									0.10		0.25				0.50	1.57
	ANL		BNL			LANL		LBNL		LLNL		NIST		ORNL				TUNL			
	PhD P	PhD T	PhD P	PhD T	T/A	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	PhD P	PhD T	T/A	GS	PhD P	PhD T	T/A	Sum
V. Nuclear Structure Physics	0.45	0.50	2.10	1.80		0.10		1.00	1.30					1.00	0.15		0.50	0.55	0.60	0.25	10.30
NSR Abstract Preparation			0.25	0.40																	0.65
Compilation of Exper. Structure Data	0.05	0.10	0.05	0.20				0.20	0.20									0.10			0.90
Eval. of Masses & Nuclides for ENSDF	0.20	0.40	1.40	1.20				0.80	0.60					1.00	0.15		0.50	0.20	0.60	0.15	7.20
Ground & Metastable State Properties																					
Radioactive Decay Data Evaluation	0.10																				0.10
Thermal Capture Gamma Data Eval.																					
Light Mass Eval. for Nucl. Physics A																		0.25		0.10	0.35
Nuclear Structure Data Measurement	0.10		0.30			0.10		0.50													1.00
ENSDF Evaluation Support Codes			0.10																		0.10
VI. Nuclear Reaction Physics	0.25		1.71	1.98	0.11	1.25	1.20					0.10	0.10	0.05	0.50		0.50				7.75
Experimental Data Compilation			0.25	0.50																	0.75
ENDF Manuals and Documentation			0.08																		0.08
ENDF Evaluations			0.60	0.40		0.30															1.30
Nuclear Reaction Standards						0.10						0.10	0.10								0.30
Nuclear Model Development			0.20	0.40		0.10	0.05														0.75
Nucl. Reaction Data Measurements	0.05					0.60	1.15														1.80
Astrophysics Nuclear Data Needs	0.20		0.10	0.58		0.10								0.05	0.50		0.50				2.03
Covariances development			0.40	0.10		0.05															0.55
Reactor anti-neutrino & decay heat calculations																					
Verification and Validation			0.08		0.11																0.19
DOE-SC Nucl. Data Funded Staff	0.80	0.50	7.66	3.88	3.61	1.60	1.20	1.00	1.30	0.26	0.12	0.10	0.10	1.20	0.65	0.25	1.00	0.60	0.60	0.75	27.18
Staff Supported by Other Funds	0.20	0.50	0.34		0.19	12.70	5.75			4.50	0.50	2.50									27.18
TOTAL STAFF	1.00	1.00	8.00	3.88	3.80	14.30	6.95	1.00	1.30	4.76	0.62	2.60	0.10	1.20	0.65	0.25	1.00	0.60	0.60	0.75	54.36

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

Detailed Status of the Work Plan

Fiscal Year 2014 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 continuous compliance of NNDC computing facilities with DOE cyber security requirements to avoid suspension of network access.	Daily and quarterly scanning were performed and discovered vulnerabilities were promptly remediated. As a result, network and Internet access to NNDC services remained highly available.
Replace the aging ADVANCE server with a new and more powerful Dell server.	The ADVANCE Server was upgraded in Jan. 2014 resulting in a more robust continuous quality assurance platform for nuclear data.
Upgrade the GForge server and the Linux cluster to meet the ADVANCE system's computing requirements.	The GForge collaboration software was upgraded which fixed some bugs and provided new, useful functionalities. The Linux cluster hardware was replaced with more powerful DELL servers thereby increasing the number of CPU cores from 74 to 120.
Provide technical computer support to NNDC staff, visitors and external collaborators in their use of NNDC computing resources.	Prompt and effective technical support were provided to NNDC staff, visitors and external collaborators to enable completion of work timely and accurately.
Enhance the capabilities of the new Linux development/working server.	Additional applications software, e.g. Fortran compilers, Mathematica, were installed on the new Linux development/working server which is the NNDC staff's daily computing workhorse.
Perform preparatory activities for the move of NNDC central computing facilities from Building 197D to 515.	Coordinated with ITD and Facilities and Operations Office to prepare the future site of NNDC servers and Linux cluster.

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
Unplanned Activity: Participate at the Joint DNP Meeting on Nuclear Structure and Nuclear Astrophysics at Texas A&M university	Organized the nuclear data session at the meeting and prepared the final report to be included in the meeting White Paper

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 FY2015 work plan for USNDP.	FY2015 work plan has been prepared in June 2014 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.
Aid LLNL to organize and chair the USNDP Task Force on Nuclear Data Needs for Homeland Security.	There has been no activity on this task in FY14.

LANL planned activities	Status
Organize and chair CSEWG Evaluation Committee meeting at BNL, November 2013.	Organized and chaired CSEWG/Cielo Evaluation meeting at BNL, November 2013.
Organize and chair Nuclear Reaction Working Group meeting at USNDP meeting in November 2013.	Organized and chaired Nuclear Reaction Working Group meeting at USNDP meeting in November 2013.

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 EGAF Capture Gamma-ray Library evaluations with LLNL for preparation of ENDF format datasets and improved RIPL files.	Measurements and evaluation of $^{23}\text{Na}(n,g)$, $^{182,183,184,186}\text{W}(n,g)$, and $^{155,157}\text{Gd}(n,g)$ have been published in Phys Rev C 89, 014617(2014), Phys Rev C 89, 014606(2014), and Nucl. Sci. Eng. 117, 219(2014), respectively. RIPL database for tungsten isotopes has been updated.
Coordinate the West Coast collaboration to measure and evaluate neutron cross section measurements at the LBNL Cyclotron, UC Berkeley Department of Nuclear Engineering, and National Ignition Facility neutron facilities.	Developed neutron beam facility from deuteron breakup, Time-of-flight, at 88" cyclotron, LBNL: Test run of $^{56}\text{Fe}(n,n'g)$ was performed (Bernstein, Kirsch). D+D Neutron Generator facility has been developed at Nuclear Engineering Dept.,UCB.

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 USNDP Task Force on Nuclear Data Needs for Homeland Security.	Continuing

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.	Completed - most recent efforts were described in the ORNL presentation at the USNDP meeting, and other efforts discussed at the July 2014 nuclear data review.
Communicate current efforts and future plans with researchers in nuclear astrophysics and nuclear astrophysics data.	Completed - discussed activities in nuclear astrophysics data and nuclear data at the Int. Symposium on Origin of Matter and Evolution of Galaxies in Japan.
Represent USNDP nuclear astrophysics efforts at international collaboration meetings on nuclear astrophysics data and in "town meetings", community meetings, and summer schools.	Completed - Chaired a session on nuclear astrophysics data at the Low Energy and Nuclear Astrophysics Town Meeting at TAMU in August 2014; wrote a resolution for the Nuclear Astrophysics Town Meeting on nuclear data; met with others to draft a similar resolution for the Low Energy Nuclear Physics Town meeting.
Initiate collaborative research projects to raise the visibility of nuclear data projects directed at astrophysics applications.	Completed - ANL and ORNL discussed plans to collaborate on advanced tools for the new nuclear mass evaluation activity that is run out of IMP Lanzhou.
Discuss future plans in nuclear astrophysics data with DOE, with USNDP/NNDC, and with other funding agencies.	Completed - plans for activities combining structure theory and nuclear astrophysics data were discussed with DOE, and the need for an FRIB data center was discussed with FRIB leadership

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 IAEA Coordinated Research Project on "Nuclear data for charged-particle monitor reactions and medical isotope production"	Participated in evaluation and measurements activities related to the IAEA-CRP on "Nuclear data for charged-particle monitor reactions and medical isotope production"
Host several international visitors to ANL to collaborate on nuclear data research projects	Hosted Prof. S. Kumar, Delhi University, India

Unplanned Activity: Participate at the IAEA-ICTP organized workshop on "Nuclear Structure and Decay Data: Theory and evaluation" in Trieste	Prepared and presented two lectures at the workshop, and participated in hands-on training activities
Unplanned Activity: Participate in the IAEA-organized technical meeting on "Improvement of Analysis Codes for NSDD Evaluations"	Completed

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 2014.	EXFOR manger B. Pritychenko participated in the NRDC meeting held at Smolenice (Slovakia).
Participate in NEA WPEC annual meeting in 2014.	M. Herman and D. Brown participated in the meetings of WPEC subgroups in May 2014 in NEA Headquarters in Paris. M. Herman led the US delegation at the WPEC meeting.
Conduct and lecture at likely IAEA-sponsored workshop at Trieste in 2014.	E. McCutchan and J. Tuli participated in a Trieste workshop.
Publish ND2013 Proceedings	ND2013 proceedings were published in the 2014 April, May and June issues of Nuclear Data Sheets.
Participate in IAEA INDC meeting.	M. Herman chaired the INDC meeting, led US delegation to the meeting and chaired working group on training and dissemination. He also discussed nuclear data program with two deputy directors of the IAEA.
Participate in IAEA organized network coordination meetings (NRDC, NSDD)	J. Tuli chaired the NSDD meeting. E. McCutchan and M. Herman also participated. J. Tuli also chaired the IAEA-organized workshop on ENSDF-related codes. T. Johnson also participated.
Continue to participate in training/mentoring of new ENSDF evaluators through collaborative work (McMaster).	Dr. Sukhjeeet Singh from India visited McMaster this year for 6 weeks for training purpose.

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	A couple of scientists participated in NEA-WPEC 2014 meeting
Participate in relevant IAEA CRP meetings (prompt fission neutron spectrum data and nuclear cross section standards).	There was no relevant IAEA CRP meetings in this period, but we participated in the Technical Meeting on model parameter inputs.
Participate and give a talk at the workshop on compound nucleus and related topics, CNR13, Oct 7-11, 2013, Sao Paulo	One person participated in CNR13, and another person had a problem to travel due to a budget issue happened in Oct. 2013.
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.	Hosted one scientist from ECN, the Netherlands, and one from JAEA, Japan, on collaboration of nuclear reaction code development.
Organize International Conference on Nuclear Data Covariances, Santa Fe, 2014	The International Conference on Nuclear Data Covariances organized.
Participate in IAEA INDC meeting	Two persons participated in the IAEA International Nuclear Data Committee meeting in June 2014.
Organize a technical meeting on the international cooperative nuclear data library	LANL co-organized the technical meeting on the international cooperative nuclear data library in Geel, Belgium, and the proceedings were published from Nuclear Energy Agency in Paris.

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 development of a website for the k0/cross section database with International k0 users committee and the IAEA.	Not performed - lack of workforce.
Coordinate EGAF and RIPL evaluation with the IAEA	RIPL database for tungsten isotopes has been updated.
Coordinate the development of a new continuum reaction/gamma-ray database with the IAEA and researchers at the Oslo Cyclotron Laboratory.	A database for continuum reaction/gamma-ray has been approved after an international co-ordination meeting held at IAEA.
Coordinate LBNL/Budapest/FRM-II/Julich TransActinide Nuclear Data Evaluation and Measurement (TANDEM) collaboration to measure actinide neutron cross sections.	An MOU with LBNL/Budapest/FRM-II/Julich has been signed for the TANDEM collaboration to measure actinide neutron cross sections.

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
Distribute database to collaborators.	Database was regularly provided to the IAEA.
Explore the possibility of cooperation with OSTI on nuclear data storage and dissemination.	The majority of NSR entries already have doi links from the the original journals. This project will provide additional capabilities to the nuclear data evaluations, rather than compilations.
Explore the possibility of cooperation with NRDC network on the transfer of selected EXFOR nuclear reaction references to NSR.	This project is in progress. 60 EXFOR references from Phys. Rev. Lett., Phys. Let. B and phys Rev. D were added to NSR.

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 McMaster University.	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
Maintain ENSDF database, includes continuous updating.	Maintained ENSDF database, including its continuous updating.
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
Distribute ENSDF database to collaborators twice a year.	Database distributed twice during the year.

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. The database was updated regularly and some minor changes to the software were also implemented.

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 and NSR databases.	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 $A \leq 12$. 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 compilations from cooperating centers (500 entries expected). The NNDC compilation work can be found under Nuclear Reaction Physics, chapter V 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-VII.1 library.	GForge/Subversion server has been maintained including its ENDF/B-VII.1 project.
Maintain and improve Sigma database and web interface for users without specialized knowledge of ENDF-6 format. (See also information dissemination, chapter IV).	Continuing.
Maintain and extend ADVANCE, the ENDF continuous integration system that continually checks for modification to the ENDF database then runs all available tests on the changed data files.	ADVANCE ported to BuildBot backend to enable distributed and easy to maintain system. ADVANCE now being used to test EMPIRE on a nightly basis.

H. Database Software Maintenance

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

BNL planned activities	Status
Fix bugs and develop enhancements for the five nuclear physics databases maintained by NNDC.	Completed.

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
Effort needed to maintain Linux/MySQL database system and improve its performance.	All the MySQL-based nuclear databases were migrated from the old to the new, more powerful DELL server. A significant increase in performance has been observed.
Implement and maintain automatic replication of updates from the internal MySQL database server to the external.	A Linux script was coded, tested and successfully implemented for a weekly automatic replication of updates.

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 updated, as needed
Maintain and upgrade Experimental Resources for Nuclear Data web site.	Maintained and updated, as needed
Maintain and upgrade ANL Nuclear Data Information web site.	Maintained and updated, as needed

BNL Planned Activities	Status
Continued improvement to the ENSDF and NSR web interfaces.	Added some minor fixes to the interface to ENSDF and fixed vulnerability issues.
Maintain web interfaces for ENDF and EXFOR databases.	Continuing.
Improve Sigma web interface by adding new and extended features following user's requests.	Continuing.
Maintain web interface for double-beta decay, B(E2) and Maxwellian-averaged cross sections and reaction rates.	Continuing.
Maintain currency of the CSEWG, USNDP and the NNDC web sites, proactively respond to the users requests.	Continuing.
Improve reliability of its 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.	This was done, and in connection with this addressed vulnerability issues.
Strictly follow all BNL and DOE cybersecurity rules and regulations during the Web application design, development and implementation.	Performed daily light scans and quarterly full scans on NNDC computer network and remediated promptly discovered vulnerabilities. As per DOE's annual security and safety audit, the NNDC computer network remained fully compliant
Maintain GForge Web site.	Continuing.
Check and upgrade when necessary all web applications for Tomcat 6 compliance.	Done.
Upgrade web servers.	Done.

ORNL Planned Activities	Status
Expansion of features of our online software suite to convert nuclear data to astrophysical reaction rates and plot, manipulate, combine, and share results online; this activity is at risk of termination.	Completed - new capabilities were added to enable the world's only online r-process calculations; new thermonuclear reaction rate data sets were entered into our system for the community to use; published datasets were converted into formats needed by the community for their research.
Expansion of host website nucastrodata.org to hyperlink in more relevant nuclear data sets for astrophysics research.	Completed - the website nucastrodata.org was rebuilt; extensive searches of online datasets were completed; results of searches were put online as a community resource.

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 1979 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 to TUNL dissertations collection.	More than 92% 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 for all reaction databases, for the NNDC web services, ENDF, EXFOR and for Nuclear Wallet Cards.	Comments/Questions options for the reaction databases were maintained although it has been noted that this form of communication with the users is losing popularity.

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 issues of Nuclear Data Sheets for publication.	Five issues of Nuclear Data Sheets, besides the three dedicated to the ND2013 proceedings, were published.
Prepare special issues of Nuclear Data Sheets with ND2013 proceedings.	The 344 articles from ND2013 proceedings were published in the 2014 April, May and June issues of Nuclear Data Sheets.
Develop software for Nuclear Data Sheets publication (McMaster)	The software has been transferred to BNL and is under consideration as the replacement of the currently used software. Some work on this package was done to adopt it for the NSDD network.

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.	3,130 new references and 2,051 key-worded abstracts were added to NSR.
Check and edit key-worded abstracts from other collaborators as applicable and necessary.	All submissions from other collaborators other collaborators were verified.

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.	Completed compilations of nuclear structure data articles for XUNDL and interacted with many of the authors
New Activity: Evaluate data for K-Isomers in Deformed nuclei and assemble a dedicated database	The K-Isomer evaluation was completed and new ensdf-formatted database was developed

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). Produce a new evaluation for even-even nuclei that will include evaluated, calculated and experimental B(E2) values.	B(E2) values for 24 nuclei have been compiled. A new evaluation of B(E2) values has been produced and submitted for publication in ADNDT journal.
Compile new double-beta decay experimental data. Produce evaluated half-lives and nuclear matrix elements.	The latest 76Ge and 136Xe data have been compiled. The evaluated half-lives and nuclear matrix elements are published in the ND2013 issue of Nuclear Data Sheets.
Maintain, update and distribute XUNDL.	Updated XUNDL on weekly basis and distributed twice a year.
Compile data sets (in ENSDF format) for current experimental nuclear structure publication. Scan the webpages of prominent journals in nuclear physics for new papers. Review compiled data sets submitted by other data centers prior to inclusion in the XUNDL database. Communicate with the authors of the original papers for data-related problems and to request additional details of unpublished data. Train a new	Compiled: 333 dataset + 14 papers on masses with 65 data points; Reviewed: 130 datasets from other compilers. Updated: 27 datasets for new papers or data received from authors. NSR, consulted ~1200 papers in PRC; about 680 keyworded

undergraduate student in 2014 for XUNDL and other compilation work. Compile new mass measurements and submit data file to nuclearmasses.org webpage at ORNL. (McMaster)	
---	--

ORNL Planned Activities	Status
Unplanned activity: Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database.	ORNL contributed 30 critical compilations to the XUNDL database.

TUNL Planned Activities	Status
Compile datasets for current experimental nuclear structure data publications on A=2-20 nuclei for inclusion in the XUNDL database.	We have compiled 50 XUNDL data sets for the FY2014.

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.	Work on A=109 and 188 is continuing. Work to address reviewer's comments and suggestions on A=112 and 209 was completed and A=112 was submitted for publication
Review mass chain evaluations, as requested.	No review was requested by the ensdf manager
Collaborate with scientists from other NSDD network centers on data evaluation projects.	Collaborated with S. Lalkovski (Sofia), S. Kumar (Delhi) and T. Kibedi (Canberra) on various ensdf-related data projects

BNL Planned Activities	Status
At least 6 mass chains, or their equivalent nuclides, will be evaluated.	7 A-chains were evaluated, A=72, 76, 83, 139, 157, 224, 235, 239, plus 39 nuclides. The total number of nuclides was 117 out of 145, representing about 80% of the total ENSDF evaluation effort.
At least 6 mass chains, or their equivalent nuclides, will be reviewed.	8 A-chains were reviewed
Continue mentoring new ENSDF evaluators.	Continued training new evaluators.
3.0 equivalent mass chains and the data for new nuclides (as mentioned below) will be evaluated. Mass chains will be reviewed as requested. Update ENSDF for the identification of new nuclides and for the first publications on the findings of the excited states of nuclides. Collaborate with a new center/evaluator as part of mentoring process, as needed (McMaster).	The following A-chains were evaluated: A=76 (with A. Farhan): 13 nuclides. A=224 (with S. Singh): 10 nuclides. A=139 (with P. Joshi, S. Singh, A. Jain); 16 nuclides; mentored Joshi. The following nuclides were evaluated: 39: 38Mg, 53Ca, 53Sc, 54Ca, 54Sc, 58Zn, 58Ti, 60Ti, 64V, 64Cr, 69Cr, 77Co, 79Cu, 79Ni, 80Cu, 80Ni, 80Zn, 80Ga, 81Cu, 100Sn 100In, 120Pd, 120Rh, 122Pd, 122Rh, 124Pd, 126Pd, 128Pd, 131Ag, 190Po, 194Re, 197Fr, 198Fr, 205Ac, 226U, 230Pa, 233Fr, 256Rf, 266Lr. Two A-chains were reviewed
All evaluations submitted for publications are edited including checking for their format and physics content. Extensive changes are often made by NNDC staff.	Continuing.

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.	Mass chain A=210 (13 nuclides) has been evaluated and published, NDS 121, 561(2014). Updated 26Si, 26P nuclides, data entry for 81As, 93Br, 93Kr, 93Rb, 186Re, and 192Au nuclides in ENSDF. In Progress: A=22 (9 nuclides), A=26 (9 nuclides).
Review mass-chain evaluations, as requested.	No request received
Work with the NNDC to include DDEP decay data and EGAF capture gamma-ray data in the ENSDF file and publish it in Nuclear Data Sheets.	Not performed yet - decay data have been published (mentioned above).
Train new evaluators to replace retiring 2.0 FTE expected by FY2014.	Training for compilation and evaluation is on going.
Coordinate XUNDL evaluation efforts with UC Berkeley/LBNL/LLNL Nuclear Data Collaboration.	Continued. Two students from Nuclear Engineering Department, UCB, are being trained for XUNDL compilations.

ORNL Planned Activities	Status
Complete evaluation of structure information for two nuclei in A=241-249 region, or others assigned by NNDC.	Completed: A-chain evaluations were finished for A=248 and A=241; evaluations of masses A=243 and 69 were published.
Review one mass chain evaluation.	Completed - Evaluations of masses A=54 and A=69 were 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 7 data sets for beta decay and beta-delayed particle emission reactions.
Evaluate and update ENSDF for A=2-20 near drip-line nuclides, especially for first observations or when ENSDF has no previous data set.	We updated ENSDF evaluations for six nuclides. 6B, 7B, 14F, 15Ne, 18Mg, 19Mg.

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.	Continuing.

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 in support of the IAEA-CRP on "Nuclear data for charged-particle monitor reactions and medical isotope production"	Evaluated decay data on 44Ti and 67Cu, required by the CRP
In collaboration with scientists from the Australian National University and under auspices of IAEA, develop new computational tools for improving data on Auger-electron emissions following radioactive decay, which are relevant to applications of medical radioisotopes	This activity is continuing

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 develop the EGAF database. Update EGAF prompt gamma-ray cross sections from new measurements. Add activation data to the EGAF file. Include improved nuclear structure data for the RIPL library in EGAF datasets. Develop a Nuclear Data Sheet publication format for EGAF data.	Continuing
Collaborate with Charles University (Prague) to perform statistical-model calculations of quasi-continuum γ -ray cascade information and generate ENDF-format capture γ -ray datasets for use with MCNP and other transport-code calculations.	Continuing
Collaborate with the University of Oslo to measure low-energy photon strength functions and level densities.	Continuing

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 any loose ends for publication of "Energy Levels of Light Nuclei A=12," and continue in preparation of the "Energy Levels of Light Nuclei A=13" manuscript.	Following publication of the nearly completed review of A=12 nuclei, we will produce only the more focused ENSDF format nuclear structure data reviews for the light mass region. A similar shift away from publications in Nuclear Physics A has recently been made regarding the A=21-44 nuclear mass region that had previously been maintained by P. Endt and C. Van Der Leun. This decision follows serious reflection that considers both the great value of the breadth of information provided in the "Energy

Levels of Light Nuclei” publications and the NSDD/ENSDF network expected 7-10 year periodicity for reviews of a given nuclear mass-chain, the only feasible direction for future evaluations is to focus solely on ENSDF reviews to be published in the Nuclear Data Sheets.

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, MSU and other nuclear physics user facilities with main emphasis on decay studies of neutron-rich fission products of relevance to reactor decay heat and astrophysics applications, spectroscopy of heavy actinide nuclei and nuclei far from the line of stability	Participated in experimental activities at ANL, MSU and LBNL with main emphasis on spectroscopy of heavy actinide nuclei, nuclei far from the line of stability and nuclei of importance to medical isotopes research and applications
Participate in research activities using the GRETINA spectrometer and in dissemination of produced data from those activities	This activity is continuing. Participated in several decay and Coulex experiments. Currently awaiting completion of the data analysis in order to include data into the databases

BNL - BNL has spent a modest amount of time to participate in experiments relevant to isotope production and nuclear structure (Unplanned activity).

BNL Planned Activities	Status
Participate in experiments relevant to nuclear reactors decay heat and antineutrino spectra	Participated in an experiment in Finland to study nuclei relevant to antineutrino spectra using the TAGS technique. Proposal to study ^{92}Rb and ^{96}Y accepted for study at CARIBU at ANL and is awaiting beam scheduling.
Participate in experiments relevant to nuclear structure Complete analyses of ^{152}Eu and ^{154}Eu decay data and publish results	Participated in an experiment at ANL using deep inelastic reactions.
Participate in experiments relevant to isotope production	Program to study production cross sections at BLIP was initiated; first measurements of protons on Platinum were performed. Proposal to study medical isotopes using Gammasphere at ANL was accepted and is awaiting scheduling.

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 fission-product nuclei to search for previously unobserved transitions in these nuclides.	We studied transitions in ^{135}Cs , ^{88}Kr and $^{92,93}\text{Sr}$. Draft manuscripts on ^{88}Kr , and $^{92,93}\text{Sr}$ are in progress. The published paper on ^{135}Cs is: N. Fotiades, et al., Phys. Rev. C 88, 064315 (2013).
Interact with mass chain evaluators on the nuclear structure of these nuclei.	No particular interactions in FY2014.

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
Perform DICEBOX statistical model calculations to determine total radiative cross sections and elucidate nuclear level spins and parities.	Continued. Determined $2\text{H}(n,g)$, $16,17,18\text{O}(n,g)$, $93\text{Nb}(n,g)$ total radiative cross sections.
Measure gamma ray cross sections at the Garching FRM-II and Budapest Reactors and produce improved (n,g) decay schemes and total radiative capture cross sections.	Measurements for above mentioned reactions were carried out in Garching FRM-II and Budapest Nuclear Reactor facilities.
Investigate primary gamma ray photon strength functions and the contribution of the M1+E2 mixing ratio to nuclear statistical model calculations.	Continued

I. ENSDF Physics and Checking Codes

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

BNL Planned Activities	Status
Maintain and upgrade ENSDF checking and physics programs for format changes as required.	Continuing work on fmtchk, in connection with moving to gfortran (next activity).
Move codes off the Lahey compiler and make compatible with gfortran.	Made a version of nndclib that works with gfortran. Continuing work on moving fmtchk over.

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 120 publications.	Experimental nuclear reaction data from 147 new publications were compiled.
Explore and update the missing and unobtainable data in EXFOR.	All U.S. and Canadian unobtainable data for H,C,O,Fe,235,238U, and 239Pu have been compiled to EXFOR database. Work on other isotopes is in progress.

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.	BNL is an active participant in the CIELO collaboration, leading the evaluation effort for ^{56}Fe . A preliminary evaluation is expected in FY15. In an effort to discern underserved customers, "big data" techniques were applied to the EXFOR database. This study identified several reactions used by the isotope production community that would benefit from deeper consideration from evaluators. This effort is written up in a BNL report.
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 CSEWG on upgraded evaluations for future release of the ENDF/B library.	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 including new W and Cu evaluations.
Improve methodology for providing angular distribution data in the resonance region and in the fast neutron region to the next release of ENDF.	The capability to directly compute compound angular distributions was added to the EMPIRE nuclear reaction code code. Also, the ability to reconstruct angular distributions for outgoing neutrons for the MLBW and Reich-Moore ENDF formats was added to the Fudge processing code.
In collaboration with LLNL, coordinate the development of the Generalized Nuclear Data (GND) format as a proposed successor format for ENDF.	Development of an ENDF successor format continues. Two WPEC Subgroup 38 meetings were held in FY14 (Paris in May and BNL in Oct) coordinating this activity. Detailed requirements documents will be presented at the May 2015 WPEC meeting.
Use the BNL-INL collaboration efforts on the assimilation of integral experiments to provide modifications to ENDF evaluations and cross-reaction covariances.	Collaboration with INL has been discontinued due to lack of funding. Work on assimilation has continued at NNDC through development of the new non-linear fitting module in the EMPIRE code. This module will be able to adjust physics model parameters to differential as well as integral data and produce covariances.

LANL Planned Activities	Status
Upgrade the LANL ENDF evaluations for U and Pu isotopes that perform well in criticality benchmarks, considering new LANSCE experimental data.	New ^{239}Pu and ^{238}U model calculation performed, including advanced coupled-channels Hauser-Feshbach model.
Provide upgraded ENDF evaluated data files for light and medium mass elements, including covariance data. Perform criticality benchmarks.	New ^{12}C and ^{13}C evaluations with the R-matrix theory continue. The ^{16}O evaluation submitted to the international evaluation files, and benchmark test calculations performed.
Provide new evaluations of the prompt fission neutron spectra for major actinides, based on the Monte Carlo technique, and perform criticality benchmarks.	New prompt fission neutron spectra evaluated and comparison of the spectra with LANSCE experimental data performed. The evaluation was based on the Madland-Nix model. However the Monte Carlo approach also continued to test model parameters in fission physics.
Provide new prompt fission neutron spectra at higher energies, which include pre-fission neutrons, based on the statistical model.	New prompt fission neutron spectra including the pre-fission neutron emission produced.

LLNL Planned Activities	Status
-------------------------	--------

Perform new evaluations as per LLNL customer requests and submit these and other LLNL generated evaluations into ENDF.	Continuing
In collaboration with BNL, coordinate the development of the Generalized Nuclear Data (GND) format as a proposed successor format for ENDF.	Continuing

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 GForge version of the ENDF-6 formats manual up-to-date with CSEWG endorsed format changes. Issue official release of the manual.	Ongoing task.
Automate the generation and posting of the latest unofficial version of the ENDF-6 formats manual.	ADVANCE has been configured to continuously update and post the latest unofficial version of the 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 $\text{Au}(n,\gamma)$ 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, and investigate the nature of output covariance data from R-matrix analyses of systems containing the light-element standard cross sections.	There was no IAEA meeting on the standards in this period. However, two major efforts on evaluating the standards continued; the light element standard cross section evaluation with the R-matrix, and the prompt fission neutron spectra.
Incorporate the cross section standards into the new ENDF evaluations, and perform validation tests with integral measurements.	This planned activity was not performed in FY2014.
Continue experiment on $\text{H}(n,n)$ angular distribution for improving the standard at several neutron energies for forward neutron scattering angles in the center-of-mass. This measurement follows the $\text{H}(n,p)$ measurements that improved the data base at backward angles. We collaborate with researchers at Ohio University and NIST.	This project is making progress, but slowly, because of the termination of DOE-NE funding at Ohio University's Accelerator Laboratory. We emphasized that Monte Carlo modeling is essential before experiment, and this is being carried out by a collaborator.
Continue the search for suitable $(n,x\gamma)$ reactions as possible reference cross sections to complement or replace the $^{56}\text{Fe}(n,x\gamma)$ $E_{\gamma} = 847$ keV reaction, which has several experimental limitations.	We continue to work on this project and are concentrating on $^{7}\text{Li}(n,n')$ ($E_{\gamma} = 478$ keV) and $^{48}\text{Ti}(n,n')$ ($E_{\gamma} = 984$ keV) as alternatives to the 847-keV gamma-ray from inelastic scattering on ^{56}Fe . We communicate especially with Dr. Plompen of IRMM (Belgium) in this work.

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.	Work continues on the IAEA data development project on maintenance of the neutron cross section standards. Preparations have been made for the next IAEA Consultants' Meeting on this project. At that meeting an update on the standards experimental database will be given with some information on its impact on the standards.
Prepare a publication on standards activities.	A publication on the standards activities was prepared for the International Symposium on Reactor Dosimetry. The title of the publication is "Toward a New Evaluation of Neutron Standards"
Continue to recommend and encourage new measurements and perform examinations of the data from them for use in future evaluations of the standards.	We Continue to recommend and encourage new measurements and perform examinations of the data from them for use in future evaluations of the standards.
Continue work on an experiment using neutron detection to measure the $\text{H}(n,n)$ angular distribution. This work will lead to improved determinations at small center-of-mass angles. The focus will be on an experiment at 10 MeV. Work will also be done at 14.9 MeV. This work is done in collaboration with Ohio University, LANL and the U. of Guelma.	We continue work on an experiment using neutron detection to measure the $\text{H}(n,n)$ angular distribution. This work will lead to improved determinations at small center-of-mass angles. The focus will be on an experiment at 10 MeV. Efforts have been placed on a deuterium gas target for the measurements. Work will eventually also be done at 14.9 MeV. This work is done in collaboration with Ohio University, LANL and the U. of Guelma.

Work on an experiment 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 is progressing on an experiment based on ^{252}Cf nu-bar that should lead to an improved calibration of NBS-I, the U.S. national primary standard neutron source and determination of our bath efficiency. A new ^{252}Cf source has been ordered for this experiment.
Complete a measurement of the $^6\text{Li}(n,t)$ standard cross section at ~ 4 meV neutron energy using an improved fluence determination based on alpha-gamma coincidences with the $^{10}\text{B}(n,\alpha)$ reaction. Study stability of ^{10}B deposits for $^{10}\text{B}(n,\alpha)$ cross section measurements. If suitable targets can be made, cross section measurements will be initiated.	The measurement has been completed of the $^6\text{Li}(n,t)$ standard cross section at ~ 4 meV neutron energy using an improved fluence determination based on alpha-gamma coincidences with the $^{10}\text{B}(n,\alpha)$ reaction. A Study has been initiated of the stability of ^{10}B deposits for $^{10}\text{B}(n,\alpha)$ cross section measurements. If suitable targets can be made, cross section measurements will be initiated.
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.	We continue to acquire and monitor samples in the National Repository for Fissionable Isotope Mass Standards. These samples are available for loan in physics experiments.

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 CoH3 (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 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 CoH3. 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
Continue to improve reaction modeling in the EMPIRE code, maintain code's numerical integrity and enhance user friendly GUI.	Major changes in the EMPIRE code performed in FY14 include: - Internal calculations of CN angular distributions - Tlj coupling with the new HRTW-comp subroutine (F95) - Non-linear fitting/covariance package based on CERNLIB (an alternative to Kalman filter and MC,) - Fully functional Windows version - main.f completely rewritten to make it modular - Adding ECIS-2013 - Several modules converted to Fortran-95
Improve EMPIRE covariance capabilities for fast neutrons.	New non-linear fitting module, making use of the CERNLIB package MINUIT has been developed for adjusting model parameters and producing relative covariances.
Maintain GForge site with the current version of the EMPIRE code.	Continuing.
Implementing continuous integration system ADVANCE for checking and validation of new EMPIRE versions.	EMPIRE is being rebuild and checked nightly by the NNDC's ADVANCE system. The results are published at http://www.nndc.bnl.gov/empire/nightly.html .

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 CoH3 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 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 $^{239,240}\text{Pu}$, to validate this new fission theory.	The fission model that includes the Class-I and II state coupling was developed, and a Phys. Rev. C paper was published, in which calculated fission cross sections for major actinide are given.
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, and s-process nucleo-synthesis studies.	The coupled-Channels Hauser-Feshbach method was applied to Sm and Ho isotopes, as well as U-238, and the neutron capture cross sections were calculated. A Phys. Rev. C paper on U-238 showed a strong impact on the M1 strength.
Study neutron elastic scattering angular distributions in the fast energy range, which have high sensitivities to the simulation for critical assemblies.	The neutron elastic scattering angular distribution was studied. A paper was published in J. Nucl. Sci. Technol., and the result was presented at the Workshop on Elastic/Inelastic Scattering (WINS2014) in Dresden, Germany.
Study neutron inelastic scattering from actinides in the fast energy range, to which theoretical calculations are essential, in collaboration with CEA, France.	The neutron inelastic scattering off actinides studied in collaboration with CEA/DAM and IAEA. A new treatment of the channel-coupling in the statistical model was incorporated into the Hauser-Feshbach nuclear reaction code.

Perform prompt fission neutron and gamma-ray spectrum calculations with the Monte Carlo method to ^{235}U , ^{239}Pu , and ^{252}Cf , and compare available experimental information.	The prompt fission neutron and gamma-ray spectra were calculated with the Monte Carlo technique, and the results were compared with the available experimental data. Several invited talks were given, and two Phys. Rev. C papers were published.
Develop a new method to calculate the width fluctuation correction factor in the fast energy range, based on the Gaussian Orthogonal Ensemble and the Monte Carlo technique.	The new width fluctuation correction factor was derived from the Gaussian Orthogonal Ensemble technique, and it was published in Nuclear Data Sheets.
Continue to develop Monte-Carlo Hauser-Feshbach code, CGM, that can be used as an event generator in radiation transport codes.	The development of the Monte-Carlo Hauser-Feshbach code continued. Incorporation into the radiation transport code underway.

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
Participate in nuclear data activities at ANL using the Accelerator Mass Spectrometry technique and recently irradiated actinide samples at INL	Participated in nuclear data activities at ANL related to the MANTRA project, including decay data measurements on irradiated samples and AMS experiment at ATLAS

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 near mass 60.	A paper on reactions on ^{60}Ni is in progress.
Continue to improve the techniques to measure the fission-neutron spectrum for fission induced by neutrons of 0.5 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 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 FY14, we will begin measurements on the portion of the fission neutron spectrum below 1 MeV for ^{239}Pu .	We carried out first production runs on ^{239}Pu in FY14 with an array of 22 detectors of ^6Li -glass to concentrate on fission neutrons below 1 MeV. Preliminary data were encouraging and are leading the way to further improvements in the fission chamber, the data analysis and Monte Carlo modeling to quantify the effects of down-scattered neutrons. The Parallel-plate Avalanche Detector (PPAC) was found to give better discrimination between alpha particles and fission fragments with reversal of the electric field. Backgrounds were determined to be caused by accidental coincidences between events (mostly alpha particles) in the PPAC and background neutrons in the neutron detectors. This background is tricky as it differs for different ranges of incident neutron energy and also for out-going neutron energies. We can now determine it with very high statistical accuracy from the singles rates measured online in the same run.
Conduct proof-of-principle measurements of neutron inelastic scattering at the Chi-Nu facility at WNR with neutron emission below 1 MeV.	We did not make progress on this effort in FY14. Data from previous runs will be analyzed.
Continue the study of radiative strength functions in neutron capture on ^{167}Er and ^{195}Pt . The residual nuclei in their low-lying states are those characterized as a strongly deformed rotator (^{168}Er) and a transitional, soft-gamma nucleus (^{196}Pt). The gamma-ray cascades differ markedly for neutron capture in these two nuclear systems. (with Yale University)	Data have been analyzed and models of radiative decay were implemented with the DICEBOX code. Nuclear structure of several isotopes was analyzed in the framework of partial dynamical symmetries: R.F. Casten, et al., Evidence for Partial Dynamical Symmetries in Atomic Nuclei, Phys. Rev. Lett. 113, 112501 (2014).
Measure neutron capture-to-fission cross section ratio for ^{239}Pu for neutron energies less than 200 keV.	A paper was completed and published for incident neutron energies up to 1 keV. Data for incident neutrons between 1 and 200 keV are in the final stage of analysis. S. Mosby, et al., Improved neutron capture cross section of Pu239, Phys. Rev. C 89, 034610 (2014).
Measure the neutron capture cross-section at DANCE for at least one radioactive isotope of importance to nuclear astrophysics.	The neutron capture cross section measurements of ^{173}Lu (1.37y) and ^{63}Ni (101.2y) at DANCE were completed: O. Roig, et al., Measurement of $^{173}\text{Lu}(n,\gamma)$ Cross Sections at DANCE, Nuclear Data Sheets 119, 165 (2014); M. Weigand, Die (n,gamma) Wirkungsquerschnitte von ^{63}Ni und ^{63}Cu im astrophysikalischen s-Prozess, Dissertation zur Erlangung des Doktorgrades der Naturwissenschaften (2014).

LANL: LANL 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 LANL and outside groups at LLNL and the University of Richmond that is currently funded from outside of the DOE Data Program. The LANL 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. LANL is collaborating with the Budapest Reactor Centre in the measurement, using isotopically-enriched targets, of selected thermal (n,y) 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, γ) cross sections using guided neutron beams in collaboration with the Budapest Research Centre and at the Munich Reactor.	Continued. Mentioned above.
Investigate nuclear level densities and gamma ray strengths at the Budapest and Munich Reactors and the LBNL 88" cyclotron, and the UC Berkeley neutron generator laboratory. Develop improved statistical model calculations in collaboration with Charles University, Prague.	Under development.
Measure nuclear cross sections in the plasma at the LLNL National Ignition Facility.	Continued.

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
Compile and evaluate nuclear structure and decay data for neutron-rich nuclei in the fission fragments region, produced at the CARIBU facility (ANL), that are of relevance to modeling of the r-process nucleosynthesis.	This activity is continuing
Contribute to the development of the Atomic Mass Evaluation and NUBASE libraries that are scheduled for distribution in 2015	Continuing evaluating nuclear structure and atomic masses data as a part of the AME collaboration
Develop new computational tools aimed at studying the sensitivity of atomic masses and other nuclear ground state properties on the astrophysical r-process	This activity is continuing

BNL Planned Activities	Status
Continue work neutron capture and fission integral values and their uncertainties in the energy region of interest for nuclear astrophysics.	The results and recommendations on astrophysical cross section uncertainties have been presented at the Covariance Workshop in Santa Fe. This activity is continuing.

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.	An improved treatment of nuclear deformation was implemented in the statistical Hauser-Feshbach code for calculating the neutron radiative capture cross sections, which includes an exact transformation of the S-matrix into the diagonal space.
Continue working on beta-delayed neutron emission rates in the astrophysical stellar environment, including explicit neutron and gamma-ray competition.	The beta-delayed neutron and gamma-ray emission rates for one thousand elements were calculated, and r-process nucleosynthesis simulations were performed.

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 beam facilities.	Completed - a paper on the beta decay of fp-shell nucle important for rp-process burning in X-ray bursts was published, and a paper on levels in ^{27}Si relevant for the destruction of ^{26}Al in stellar explosions was submitted for publication.
Extract spectroscopic information (excitation energies, spectroscopic factors, spins, parities, ANC's) on nuclei near the N=82 closed shell – ^{81}Ge , $^{127,129}\text{Sn}$, ^{135}Te - from transfer reaction measurements on radioactive Ge, Sn, and Te nuclei. This information is important for modeling the r-process in supernovae.	Completed - significant progress was made in calculations of the direct capture cross section of exotic Sn nuclei, and in benchmarking the techniques to provide nuclear structure information for these calculations both from USNDP databases and from theoretical calculations; a paper on this project has been drafted.

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 Planned 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 work has been discontinued after DOE-NE funding contribution has been terminated.
--	---

I. Reactor antineutrino spectra and decay heat calculations

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

BNL Planned Activities	Status
Setup methods and databases to calculate anti-neutrino spectra for major actinides.	A workshop on antineutrino spectra from nuclear reactors was organized at the Institute for Nuclear Theory in November 2013. A follow up workshop, which we co-organized will take place in France during January 2015. An article with our calculations was submitted to PRC in August 2014.

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 Planned Activities	Status
Establish automatic, real time verification and validation of the new/modified ENDF evaluations submitted to the NNDC GForge server.	ADVANCE, NNDC's continuous integration system now performs physics, formatting and checks of processed data automatically. Tests include all NNDC checking codes and processing with LANL's NJOY code, LLNL's Fudge code and Red Cullen's PREPRO codes. Current results are available at http://www.nndc.bnl.gov/ndf/b7.dev/qa/index.html .

Appendix A

Nuclear Data Activities Funded from Sources outside the Nuclear Data Program (Report FY2014)

BNL
<p>Additional support for the nuclear data work at the National Nuclear Data Center comes from the following sources:</p> <ol style="list-style-type: none"> Elsevier supports the production of computer-generated photo-ready copy of manuscripts for the Nuclear Data Sheets. The US Nuclear Criticality Safety Program (NCSP), funded by DOE NNSA, 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
<p>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.</p> <ol style="list-style-type: none"> 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. Advanced Fuel Cycle (AFC). This supports the development of improved nuclear data important for transmutation in the fast neutron energy region. Recent focuses have been improved ENDF data on actinides, including prompt fission neutron spectrum data and covariances. This program also supports experimental nuclear reaction measurements at LANSCE.

3. 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.
4. LANL LDRD. There are 2 LANL LDRD projects that support nuclear reaction data measurements and nuclear astrophysics r-process network calculation.
5. 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.
6. Two ARRA stimulus funds support development of neutron cross section covariances and nuclear reaction modelling for actinides.

LBL

1. ARRA research stimulus funds received this year funded 1.0 FTE for ENSDF mass chain evaluation and capture gamma-ray library evaluations in collaboration with LLNL.
2. FOA 09-13 Applications in Nuclear Science and Technology funding has been received from the DOE Office of Science to support 1 FTE staff scientist and 1 FTE postdoc in the analysis of capture gamma-ray data and particle/gamma-ray coincidence data using LBNL STARS/LiBeRACE at the 88" cyclotron.
3. A 5×10^{11} n/s D+D neutron generator has been constructed using NSF funds and is being installed on the Berkeley campus. Additional funding has been requested from the Office of Science for cross section measurements.
4. 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.
5. 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 ^{239}Pu 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.

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.