USNDP

U.S. Nuclear Data Program
Work Plan for
Fiscal Year 2005

Prepared by:
Charles L. Dunford
National Nuclear Data Center
Brookhaven National Laboratory
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With Contributions from:
Coral Baglin, LBNL
Allan D. Carlson, NIST
Mark B. ChadwicK, LANL
Robert Haight, LANL
Richard Helmer, Idaho
John Kelley, TUNL
Filip G. Kondev, ANL
Dennis McNabb, LLNL
Pavel Oblozinsky, BNL
Balraj Singh, McMaster U.
Michael Smith, ORNL
Constance Walker, TUNL

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Introduction

The work plan described in this document has been developed to cover work to be done by the United States Nuclear Data Program (USNDP) during fiscal year 2005 that begins on October 1, 2004. Previously, five work plans have been prepared for the data program covering fiscal years 2000, 2001, 2002, 2003 and 2004. This plan has been prepared in consultation with the members of the Coordinating Committee who represent the organizations participating in the program. Each Coordinating Committee member prepared a draft plan for his or her organization. Each contribution was integrated into a unified work plan. The draft plan was then circulated to the Coordinating Committee for comments and corrections before the final document was submitted to the Department of Energy

As was the case in the work plan for FY2004, the tasks proposed by the various organizations were reviewed internally according to the following criteria which were developed considering the mission and goals outlined in past review panel reports and oversight committee discussions, and in consultation with the DOE program manager.

1. A task should meet one of the three program priorities:

    a) The maintenance and update of information in the USNDP nuclear physics databases;
    b) The improvement of dissemination of the information contained in those databases to the user community;
    c) The modernization of data evaluation software used by the program participants.

2. A task should be useful to more than a single user community.

3. A task should not duplicate effort within or outside the program.

The plan is divided into six major components. Specific tasks have been assigned to one of these components. They are as follows:

- NNDC Facility Operation
- Coordination
- Nuclear Physics Databases
- Information Dissemination
- Nuclear Structure Physics
- Nuclear Reaction Physics

The following section details the proposed work plan for FY2005, defining tasks, organizational responsibilities, and deliverables. It is envisioned that this document will serve as the basis for a performance review at the end of fiscal year 2005.

An effort table follows the detailed work plan. This effort table provides a summary of the total effort devoted to the defined tasks and the distribution of this effort by organization. The effort table shows essentially a constant level of permanent effort as compared to the FY2004 plan with a slight increase of about 0.6 FTE of scientific and professional effort accompanied by a 0.5 FTE decrease in support staff. The BNL increases by 0.25 due to a full time hire replacing a ¾ time staff member. McMaster has added a ½ time post doc to their program. In addition, ORNL plans to hire 2.5 temporary scientific/professional staff (students) for FY2005 that are not included in DOE supported effort as the funds are being taken from reserves.

The proposed Presidential budget for the nuclear data program for FY 2005 contains additional money for an initiative in the area of data compilation and evaluation. The increase if approved by Congress, would add approximately 1.0 FTE to the program in FY 2005. The USNDP plans to add 2 post docs at mid-year of FY2005, one at LBNL and one at BNL, for training as nuclear structure (ENSDF) evaluators.

For the second year, the effort table contains a complete reporting of the nuclear data effort supported by other organizations, largely NNSA, which again amounts to about 56% of the total U.S. nuclear data effort.

Finally, if an organization submits a document that gives a more detailed explanation of their work plan for FY 2005, it is attached as appendix.

The following table summarizes the USNDP Nuclear Data Program metrics for previous years and provides projections for the current year and the year for which this work plan was written.

US Nuclear Data Program Metrics

Fiscal Year	Compilations	Evaluations	Dissemination (retrievals in thousands)	Reports	Journal Papers	Invited Talks
2001*	7139	334	667	21	25	22
2002*	6159	300	799	23	40	22
2003*	4975	260	987	27	40	23
2004**	5500	280	1250	35	36	30
2005**	5300	280	1500	22	36	23

* Actual ** Projected

All statistics refer only to those results that can be attributable to work performed under nuclear data program funding. If it is not possible to separate a statistic from the total for full funding, then the resulting number used in this table has been estimated using the ratio of DOE nuclear data program funding to total funding.

Compilations

The total number reported is the sum of the new entries added to the USNDP bibliographic and experimental databases.

- NSR, nuclear physics bibliography – number of new references entered.
- CINDA, neutron reaction physics bibliography – number of new experimentally measured reactions added.
- XUNDL, experimental nuclear structure measurements – number of experiments from which new data have been added.
- CSISRS, experimental nuclear reaction data – number of reactions for which new data has been added.

Evaluations

The total number reported is the sum of new evaluations submitted or accepted for inclusion in the USNDP evaluated nuclear databases.

- ENSDF, evaluated nuclear structure – number of nuclides for which new evaluated data have been submitted.
- ENDF, evaluated nuclear reactions – number of reactions for which new evaluated data have been submitted for inclusion in ENDF/B.

Dissemination

The figure reported is the number of electronic retrievals made from USNDP maintained Web or Telnet sites. This number is defined as the number of times a user places a request for data from any of the databases and receives a result. Total pages, GIFs, *etc*., accessed is not tallied here. Where only total "hits" are supplied, the number reported has been renormalized using the ratio derived from the BNL site. Non-electronic dissemination is not included as it is small compared to electronic publication. Likewise, it is impossible to estimate an equivalent value for a publication such as the "Wallet Cards".

Also not counted are regular transmissions of the 5 major databases (ENSDF, ENDF, NSR, CINDA and CSISRS) by BNL to cooperating national and international centers and organizations that further disseminate the data. Examples are ENDF to LANL and NSR to the IAEA.

Reports

All technical documents or papers except journal publications and invited talks that are tabulated separately are reported here. No administrative documents such as meeting minutes are reported.

Papers

The number given for papers refers only to articles published in refereed journals.

Invited talks

Presentations given at the invitation of the organizers of a conference, symposium, workshop, training course, etc. are given under this category.

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Work Plan Tasks and Deliverables

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.

C. Computer Operation

The NNDC operates several servers running Red Hat Linux in support of their 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. This task includes software upgrades, hardware and software procurements, machine operations and internal user support for both the Linux and Windows platforms.

BNL Deliverables:

Keep downtime on the central database and production servers to less than 3%.
Ensure compliance with DOE computer security requirements.
Maintain hardware and software of Linux-based servers.
Maintain hardware and software of Windows-based desktop computers.

II. Coordination

A. National Coordination

ANL -- Chair the Measurement and Basic Physics Committee of the Cross Section Evaluation Working Group.

ANL Deliverables:

Attend the annual CESWG meeting in November 2005.
Provide Measurement and Basic Physics Committee report for CSEWG.

BNL -- Chair USNDP Coordinating Committee, chair Cross Section Evaluation Working Group, develop USNDP work plan, and maintain its Web site.

BNL Deliverables:

Prepare FY2006 work plan for USNDP in time for spring 2005 FWP submittals.
Organize and chair CSEWG Meeting at BNL in November 2004.
Organize and chair USNDP Meeting at BNL in November 2004.
Edit and publish summary reports of the CSEWG and USNDP meetings.
Maintain CSEWG and USNDP Web sites.

LANL -- Chair U.S. Nuclear Data Program's Nuclear Reaction Working Group and help coordinate nuclear reaction data work at different labs to advance USNDP; chair Evaluation Committee of the Cross Section Evaluation Working Group.

LANL Deliverables:

Organize and chair CSEWG Evaluation Committee meeting at BNL, November 2004.
Organize and chair Nuclear Reaction Working Group meeting at USNDP meeting in November 2004.
Help organize and help lead the CSEWG Homeland Security Task Force, and interact with LANL homeland security and nonproliferation researchers to provide feedback on user needs.

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 Deliverables:

Organize and chair Nuclear Structure and Decay Data Working Group meeting at USNDP meeting, November 2005.

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 Deliverables:

Summarize USNDP efforts in nuclear data for nuclear astrophysics at USNDP Meeting in November 2004

Communicate current efforts and future plans with researchers in nuclear astrophysics data

Discuss future plans in nuclear astrophysics data with USNDP/NNDC and DOE

TUNL -- Chair task force on "The Impact of Nuclear Data on Society"

TUNL Deliverables:

No activity planned for this year.

B. International Coordination

ANL – Represent U.S. measurements interest in the NEA Working Party on International Evaluation Cooperation

ANL Deliverables:

Attend NEA WPEC annual meeting.

Contribute to development and maintenance of a recently upgraded NEA system for compiling requests for nuclear reaction data measurements and evaluations

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 and chair of WPEC. BNL frequently participates in IAEA sponsored activities such as Workshops and Technical Meetings.

BNL Deliverables:

Participate in the IAEA-sponsored NRDC technical meeting in 2005.

Participate in the IAEA-sponsored NSDD meeting in 2005.

Participate in NEA WPEC annual meeting in 2005 and chair this meeting.

Provide lecturers for the IAEA nuclear structure and nuclear reactions training workshops in 2005.

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 chair NEA/WPEC committees on covariance data, fission spectra 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 Deliverables:

Host the next international nuclear data conference (ND2004) to be held in Santa Fe, September 26-October 1, 2004.

Participate in NEA/WPEC May 2004 meeting.

Participate in relevant IAEA CRP meetings.

Make latest version of NJOY data processing code available to the international community.

Host a couple of international visitors to LANL to collaborate on the evaluation of reaction data, such as Vladimir Pronyaev (fission standards).

LBNL – Participate in IAEA-sponsored training workshops and coordinated research programs on nuclear structure and decay data.

LBNL Deliverables:

Provide lecturer(s) for structure and decay data evaluator-training Workshop if one is scheduled during FY05.

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 Deliverables:

Database distributed to collaborators monthly.

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. While the emphasis remains on recent high-spin physics publications, many low-spin studies are also included. 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 Deliverables:

Update database as input is received from McMaster..

C. Evaluated Nuclear Structure Data File (ENSDF)

The NNDC is responsible for the ENSDF database that contains evaluated experimental nuclear structure and decay data. The NNDC is responsible for maintaining the database and organizing the quality control (review) of evaluations submitted for inclusion. This task includes database updates and distribution to collaborators. Updates are done upon completion of reviews. Corrections are implemented on a continuing basis.

BNL Deliverables:

Database distributed to collaborators twice a year.

D. Numerical Nuclear Data File (NuDat)

The NNDC is responsible for NuDat, an all numeric database of nuclear data including level and γ-ray properties extracted from ENSDF, ground and metastable state properties (Wallet Cards), atomic and nuclear radiations derived from ENSDF and thermal neutron cross sections and resonance integrals. The database is also available in a stand-alone PC version.

BNL Deliverables:

Distribute NuDat database to collaborators twice a year.

E. Neutron Reaction Data Bibliography (CINDA)

The NNDC is responsible for the CINDA database that contains references to nuclear reaction data in the published and unpublished literature. Its contents are produced cooperatively by the four international neutron data centers with updates exchanged in an agreed computer format. The data are organized by data measured, not by reference. The database serves as an index to the neutron data contained in the experimental database, CSISRS. The database is updated as transmissions from the data centers are received and checked.

BNL Deliverables:

Update CINDA database with CINDA transmissions from cooperating centers (12 expected).

F. Experimental Reaction Data File (CSISRS)

The NNDC is responsible for maintaining the CSISRS database. This database contains experimentally measured nuclear reaction data covering low- and intermediate-energy regions. Many groups worldwide compile and exchange experimental data in an agreed format, EXFOR. The effort described here includes the quality control, file update and data exchange activities. The database is updated, as transmissions from the compiling centers are received and checked. The compilation activity is given under Nuclear Reaction Physics.

BNL Deliverables:

Update CSISRS with EXFOR exchange tapes from cooperating centers (20 expected).

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. A new version of the library, ENDF/B-VII, is being prepared by the members of the Cross Section Evaluation Working Group. There will be no more releases of ENDF/B-VI; the work will focus on ENDF/B-VII.

BNL Deliverables:

Maintain CSEWG Web site; keep information current.

Maintain Preliminary ENDF/B-VII website to facilitate ENDF/B-VII review process.

Maintain ENDF discussion list to facilitate validation of ENDF/B-VII.
Assemble ENDF/B-VII library for release in FY06.

H. Database Software Maintenance

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

I. Future Database Systems

As discussed in the work plans for the previous years, the NNDC is involved in a multi-year project to migrate its databases to a relational format. In FY2003, the Linux/Sybase computing environment was established using newly purchased Dell hardware. In FY2004, the migration and testing of the software supporting the nuclear structure data activities and databases (NSR, ENSDF and NuDat) was completed. Migration of the software supporting the nuclear reaction data activities and databases (CINDA, CSISRS and ENDF) was completed in FY 2004. Testing of the migrated nuclear reaction data software will be completed in the first quarter of FY2005 and full implementation of the NNDC activity in the new computing environment will be completed in the second quarter of FY2005 at which time the legacy OpenVMS system will be retired.

BNL Deliverables:

Complete testing of the migrated software, which supports the nuclear reaction data activities and databases (CINDA, CSISRS and ENDF) to the new computing environment.

Terminate operation of legacy HP Alpha Server that operates under OpenVMS.

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. Maintenance of Remote Access to USNDP Databases

The NNDC provides electronic access to the nuclear physics databases that it maintains. This access is supported *via* the Web.

BNL Deliverables:

Complete move of Web interfaces from OpenVMS to Linux.

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.

C. Web Site Maintenance

USNDP members who offer information through a web site require resources to maintain currency and improve performance. All sites will coordinate their effort and implement a "USNDP approved site" program with an appropriate identifier.

ANL Deliverables:

Maintain electronic access to the ANL Nuclear Data Measurements (ANL/NDM) report series web site.

Maintain and upgrade Experimental Resources for Nuclear Data Web site.

Maintain and upgrade ANL Nuclear Data Information Web site.

BNL Deliverables:

Effort required maintaining the currency of the CSEWG, USNDP and the NNDC Web sites.

LANL Deliverables:

Include access to new reaction and structure data evaluations, supported by DOE/Nuclear Physics, via the T-16 Web site.

Provide actinide ENDF/B-VII data via LANL's WWW site for criticality data testing.

LBNL Deliverables:

Maintain and update the home pages for neutron-capture gammas, nuclear structure and decay systematics, nuclear science education, atomic masses, and others.

Support Isotope Explorer 2 and 3 and NSR search software previously developed by LBNL.

LLNL Deliverables:

Maintain LLNL's Nuclear and Atomic Data Viewer.

Extend the Nuclear and Atomic Data Viewer to handle other data formats (esp. Monte Carlo data).

Maintain and upgrade LLNL's Computational Nuclear Physics web pages.

ORNL Deliverables:

Continue to maintain, update, and improve the WWW/FTP site providing the RadWare interface to ENSDF and XUNDL data sets

Begin porting the RadWare-to-ENSDF conversion program for use in Microsoft Windows

Investigate the development of a Microsoft Windows application for displaying and editing RadWare level schemes, as a helper application for WWW browsers

Develop online software suite to convert nuclear data to astrophysical reaction rates and plot, manipulate, and share results online

TUNL Deliverables:

Prepare PDF and HTML documents of the most recent TUNL reviews of A = 11 and 12 nuclei. PDF and HTML documents are currently available for TUNL and FAS publications for the years 1968-present.

Provide PDF and HTML documents for older FAS reviews for the A = 3 - 20 series; prepare PDF and HTML documents for earlier Fay Ajzenberg-Selove evaluations based on A = 5 - 10 (66LA04) and A = 5 - 20 (56AJ76).

Continue to provide General Tables to accompany the most recent TUNL reviews of the A = 3 - 20 series; update General Tables for A = 11 and 12 nuclei to correspond to the review to be published in *Nuclear Physics A*.

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 Ajzenberg-Selove reviews.

V. Nuclear Structure Physics

A. NSR Abstract Preparation

The literature search and preparation of KEYWORD abstracts for publications included in NSR require scientific expertise. NNDC staff creates most of the entries, but receives some assistance from Russia.

BNL Deliverables:

Prepare entries for 4100 new references and keyword abstracts for 3100 of them.

B. Compilation of Experimental Structure Data

This activity involves compilation of recently published or completed experimental nuclear structure data for inclusion in XUNDL.

McMaster Deliverables:

Compile data sets (in ENSDF format) for current publications with emphasis on high-spin physics, but selected low-spin and decay data publications will also be compiled.

Compile, on a time available basis, high-spin data from older publications not yet incorporated in outdated ENSDF evaluations

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. On an annual basis send a copy of all such private communications to NNDC for archival and distribution purpose.

ORNL Deliverables:

Improve software for converting tabular/graphic published level-scheme data from journals and unpublished data supplied by researchers to Radware database into ENSDF format.

Finish debugging code that was recently ported from Fortran to C.

C. Data Evaluation for ENSDF

The USNDP evaluates nuclide and mass chain nuclear structure and decay data for inclusion in the ENSDF database. This effort now includes the A=21-44 mass region previously evaluated by the Utrecht group; LBNL is responsible for A=21-30, Canada for A=31-44.

ANL Deliverables:

One equivalent mass chains will be evaluated and published.

At least one mass chain will be reviewed.

BNL Deliverables:

Hire one post doc at mid-year for training as an evaluator.
Four equivalent mass chains will be evaluated.
At least four mass chains will be reviewed.

Idaho Deliverables:

Two equivalent mass chains will be evaluated.
Two mass chains will be reviewed.

LBNL Deliverables:

Hire one post doc at mid-year for training as an evaluator.
At least 4 mass chain equivalents chosen from regions for which LBNL is responsible (including one from the A>212 region and at least one from the A=22-30 region) will be evaluated.
Mass chains will be reviewed as requested.

McMaster Deliverables:

1.5 equivalent mass chains (including one in the A=31-44 region) will be evaluated.
Mass chains will be reviewed as requested.
Update superdeformed-band data in ENSDF for new publications. All nuclides will be covered that do not require a complete and extensive reevaluation.

ORNL Deliverables:

Complete evaluation of structure information for nuclei with A=243
Evaluate structure information for A=233 nuclei
Start evaluation of A=229 nuclei
Train one new evaluator

TUNL Deliverables:

Prepare and submit ENSDF file for A=3 nuclei.
Prepare the ENSDF files for A = 11-12 nuclei corresponding with the *Nuclear Physics A* publication.

D. Ground and Metastable State Properties

This is the evaluation of data for the Nuclear Wallet Cards.

BNL Deliverables:

NNDC will publish the next edition of the Nuclear Wallet Cards.

E. Radioactive Decay Data Evaluation

Decay data for nuclides of importance for metrology are evaluated in an international collaboration. When complete, these evaluations will be entered into the ENSDF format and merged into the ENSDF database. In the United States, LBNL coordinates this project.

ANL Deliverables:

Evaluate decay data for one radionuclide.
Review decay data evaluation for one radionuclide.

LBNL Deliverables:

Coordinate and plan activities of this international collaboration.
Review the evaluations of about five radionuclides.
Submit decay datasets for two radionuclides.

Idaho Deliverables:

Decay data for 3 nuclides will be evaluated.

F. Thermal Capture Gamma Data Evaluation

As new measurements from the Budapest Reactor become available, they will be evaluated and added to the EGAF (Evaluated Gamma-ray Activation File) database that resulted from a recent IAEA CRP in which LBNL was involved. Total capture cross sections will also be extracted from those data when possible.

LBNL Deliverables:

Evaluate new (n,γ) data as they become available from the Budapest reactor, add them to the EGAF database and make the revised evaluation available for use in other relevant databases.

Collaborate with LLNL on a project (see Section VI.B) to incorporate data from the EGAF database into the ENDF/B database. Quasi-continuum neutron capture gamma-ray information will be generated as part of this project and that will also be used to refine the EGAF database.

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 Deliverables:

Evaluate and distribute preliminary review of $A = 12$ nuclides for comments.

Prepare *"Energy Levels of Light Nuclei, A = 11 - 12"* for publication in *Nuclear Physics A.*

Prepare evaluation of $A = 3$ nuclides for publication in *Nuclear Physics A.*

Begin evaluation of $A = 13$ nuclei and prepare preliminary report to be distributed for comment.

H. Nuclear Structure Data Measurement

LANL/LANSCE maintains a small program to measure nuclear decay information.

LANL Deliverables:

Examine prompt gamma-ray emission data on ^{191}Ir and ^{193}Ir to search for previously unobserved transitions.

Interact with mass chain evaluators on the nuclear structure of these nuclei.

I. ENSDF Physics and Checking Codes

The NNDC maintains ENSDF checking and physics programs on behalf of the national and international evaluator networks. Only maintenance and upgrades for format changes are planned.

BNL Deliverables:

Upgrade RADLST and LOGFT to properly treat higher-order (≥ 3) unique forbidden $\beta^{\pm}$ transitions and to use the Schönfield electron-capture probabilities.

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 only. In this fiscal year, ANL will contribute to this task.

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.

NNDC is responsible for maintaining the manuals describing the EXFOR format and the methods for compiling different kinds of data.

ANL -- Prepare EXFOR files for experimental neutron activation data measured in collaboration with IRMM.

ANL Deliverables:

Submit EXFOR files to the NEA Data Bank for those original data sets provided to ANL by IRMM for processing.

BNL Deliverables:

Compile data from 90 charged-particle and neutron reaction publications.

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 will provide neutron, proton and photonuclear reaction data evaluations for ENDF/B-VII planned for release in FY2006. LLNL will develop a computer that code translates LLNL evaluations in the internal ENDL format into ENDFB-6 formatted data so that LLNL evaluations can flow back into the nuclear data community.

ANL -- Collaborate with TSI Research (Solana Beach, CA) in conducting a survey of the status of nuclear data for helium production in fusion reactors.

ANL Deliverables:

Prepare a report on the status of nuclear data for helium production in fusion reactors.

BNL Deliverables:

Create preliminary files for recommended fission product evaluations for ENDF/B-VII (new WPEC subgroup collaboration).

Submit new evaluations for Germanium isotopes with photon production data for use in homeland security applications and ENDF/B-VII.

LANL Deliverables: (work mostly supported from other sources)

Work with BNL to coordinate upgraded evaluations for new version of ENDF: ENDF/B-VII.

Submit new improved evaluations that will eventually be available in ENDF/B-VII. For ^{235}U, create an evaluation that combines LANL high-energy evaluated data with ORNL unresolved resonance results to 20 keV. For ^{238}U, create an evaluation that contains LANL high-energy data with ORNL unresolved resonance data.

Provide criticality data testing of the actinide evaluations, in fast, intermediate, and thermal assemblies, for validation of the new ENDF/B-VII evaluations.

Complete and submit to CSEWG new actinide evaluations for americium isotopes.

Provide upgraded ENDF evaluated data files for charged-particle reactions having $A \leq 10$, correcting some problems identified in the review process.

LLNL Deliverables: (work mostly supported from other sources)

Develop FETE code to translate data in the internal LLNL format to the international standard ENDF-6 format.

Release the FETE translation code.

Submit new improved evaluations for neutron induced reactions on nuclei in the A=43-56, 74-83, and 123-158 mass regions.

Review state of actinide evaluations and make improvements based on study of systematics in this mass range for DNEA program.

LLNL - The Institute of Isotope and Surface Chemistry, Budapest has recently undertaken an extensive set of elemental measurements of capture gamma-ray energies and intensities as part of an IAEA CRP on "Development of a Database for Prompt Gamma-ray Neutron Activation Analysis (PGAA)," led by LBNL. The evaluated tables of prompt and delayed gamma-ray yields developed by this activity, called the Evaluated Gamma-ray Activation File (EGAF), are a significant improvement over previous work. LBNL and LLNL will collaborate to develop a set of ENDF files to be used to update the capture gamma-ray production information in the ENDF/B database. The availability of these data in coupled neutron-photon transport codes is very important to several national security programs. This project is leveraged by funding from those programs.

LLNL Deliverables:

Provide peer review of the EGAF database.

Simulate the gamma-ray cascade from resonance capture in order to add information on the quasi-continuum of gamma rays for A = 40 nuclei where level spacings become comparable to detector resolution. This

information is usually not available experimentally because the targets used were not typically mono-isotopic.

Extend the data files up to approximately E_n = 100 keV based on the results of the simulations.

Produce ENDF files with the discrete and quasi-continuum gamma-ray spectra.

C. ENDF Manuals and Documentation

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 Deliverables:

Maintain ENDF-6 formats manual that is available on the Web. This format will be used for the ENDF/B-VII release.

D. Nuclear Reaction Standards

Nearly all nuclear reaction data measurements are made relative to some reaction standard such as the hydrogen elastic cross section. Maintaining accurate current values for the standard cross sections is the objective of this task, which can be accomplished only through international cooperation. A new international evaluation of the neutron cross section standards was initiated to provide the improved standards that are needed. This evaluation, which should be completed this year, has been largely performed by an IAEA Coordinated Research Project (CRP) with support, largely experimental in nature, through the Working Party on International Evaluation Cooperation (WPEC) of the Nuclear Energy Agency and CSEWG.

ANL Deliverables:

Contribute to an IAEA sponsored international effort to develop a contemporary neutron reaction standards file that, when completed, will be adopted by ENDF/B-VII.

LANL Deliverables:

Host IAEA staff member in a visit to LANL to work on actinide fission cross section standards (^{235}U and ^{239}Pu), and produce new evaluations.

Participate in the international effort to reevaluate the light-element standard cross sections.

Participate in test problems designed to investigate the nature of output covariance data from R-matrix analyses of systems containing the light-element standard cross sections.

Participate in a standards measurement of the angular distribution of n-p scattering near 15 MeV with Ohio University and NIST. This quantity is the primary standard in all neutron cross section measurements.

NIST Deliverables:

Coordinate the international standards activity (Subgroup 7 of the NEA Working Party on International Evaluation Cooperation) and chair the IAEA CRP on the Improvement of the Standard Cross Sections.

Add remaining experimental data for use in the standards evaluation to the database.

Complete examination of discrepant (inconsistent) data in the experimental database that will be used for the evaluation.

Work with the CRP to perform a comprehensive evaluation of the standards.

Provide standards and uncertainties for the ENDF/B-VII library.

Complete work on understanding the uncertainties obtained from the standards evaluation.

Continue to recommend new measurements and perform examinations of the data from them for use in future evaluations of the standards.

Continue the collaboration with Ohio University and LANL on the measurement of hydrogen elastic scattering angular distributions.

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 TUNL preequilibrium code will be incorporated into the LANL code. 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.

ANL – Continue an ongoing collaboration with IRMM to utilize experimental neutron activation data for gaining an improved understanding of nuclear model parameters.

ANL Deliverables:

Assist IRMM in preparing publications to document completed work.

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 advanced treatment of the fission channel, preequilibrium emission of clusters, and merging resonance and fast neutron energy ranges. The work on validation of the code will be actively pursued, in particular in relation to emerging requirements of homeland security applications. Close collaboration with LANL will continue focusing on validation of the fission models in EMPIRE and GNASH. New algorithm for calculation of exclusive particle spectra (as required by the ENDF-6 format) will be developed and implemented in the new release of EMPIRE. Interactive, manual search of optical model parameters will be added.

BNL Deliverables:

Release new version (2.19) of the code EMPIRE with above-mentioned improvements.

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 due to the decrease in operating experimental facilities throughout the world. The LANL GNASH code has proved to be an important tool, and we will continue development of a new version of this code, McGNASH, to provide a state-of-the-art capability to predict reaction cross sections. This also involves a close collaboration with experimentalists at LANSCE to interpret new measurements using the GEANIE and DANCE gamma-ray detectors, as well as (n,charged-particle) data. These data will result in advances in our understanding of nuclear reaction mechanisms, and improvements in our modeling codes. Also, largely under DOE/DP support, we will continue modernization of our R-matrix EDA code (used for light nucleus calculations and data evaluations) and explore implementation of exact particle-exchange formalism.

LANL Deliverables:

Calculate and interpret gamma-ray reactions measured with GEANIE at LANSCE. A current area of research is understanding preequilibrium spin transfer physics, by studying residual nucleus gamma-ray decay cross sections as a "spin window". We will focus on n+^{90}Zr data initially.

Collaborate with LANSCE experimentalists on the interpretation of new FIGARO measurements of prompt neutron spectra.

Perform radiative capture calculations in support of new DANCE detector capture measurements (depends on what data are first reported by DANCE experimentalists).

Obtain information on nuclear level densities on some fission product nuclei through (n,xn γ) and (n,n') reactions.

Measure the fission neutron spectrum from neutron-induced fission of ^{237}Np with the FIGARO array for neutron energies from 1 to 100 MeV. Collaborators include scientists from CEA (France.) The data will test the Los Alamos Model of fission neutron emission.

Measure neutron capture cross sections on radioactive nuclei at DANCE with the goal of deriving nuclear level densities for nuclei off stability from neutron capture resonances.

TUNL – Ongoing work involves the development of preequilibrium nuclear reaction models, as well as the improvement and benchmarking of the computer code PRECO. Specific tasks to be undertaken are difficult to predict because this is basic research where the amount of effort required and the direction that will result is unknown ahead of time. Current plans involve completing preparations for a new release of PRECO, and extending model verification—and, where necessary, modification—as well as code benchmarking for (N,N) reactions to higher incident energies. This involves studying the incident energy dependence of the matrix elements for the residual interactions causing nuclear energy equilibration. Other tasks may be substituted based emerging developments and user input.

TUNL Deliverables:

New release of PRECO and its users manual.

An expanded dataset of spectra for (N,N) reactions at incident energies of 40 to 100 MeV or higher.

Possible revisions to the models and/or global input set, and thus to the code.

F. Nuclear Reaction Data Measurements

LANL -- The nuclear data for fission products are important for a number of applications. This task is related to the evaluation activity described in Section VI.B.

LANL Deliverables:

Complete the experiment and analysis of prompt neutron emission following interactions of fast neutrons with ^{99}Tc gated by gamma rays in the residual nuclei.

Measure prompt gamma rays from neutron interactions a with stable fission product nuclei, e.g. molybdenum isotopes and ^{130}Te, with the goal of deducing partial reaction cross sections.

Measure the neutron capture cross section of ^{237}Np at DANCE for neutron energies less than 200 keV.

Measure neutron capture cross section at DANCE on at least one radioactive isotope of importance to nuclear astrophysics.

LLNL Deliverables:

Neutron induced reaction measurements on one or more isomer targets.

Perform surrogate (n,n'), (n,2n), (n,γ) and (n,f) measurements on several nuclei with programmatic and/or astrophysical importance.

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 – Continue ongoing collaboration with ORNL on the development of methods to handle nuclear data uncertainties in stellar nucleosynthesis calculations.

ANL Deliverables:

Assist in preparing publications to document completed work.

BNL – In support of the increasingly sophisticated nuclear data needs for astrophysics, NNDC is involved in a joint project with VNIIEF, Sarov, Russia, and ORNL to compile α-induced nuclear reaction cross sections for astrophysics. The work, partially funded by the U.S. Civilian Research and Development Foundation, focuses on α-like nuclei with $8 < Z < 32$ and incident energies below 20 MeV. These reactions are important in the helium burning stage of stars, novae, and supernovae events. Compilation of (α,α), (α,n), (α,p) and (α,γ) data should be completed in FY 2004. These data should be analyzed, used to deduce optical model potential parameters and validate cross sections obtained by model calculations.

BNL Deliverables:

Deduce α-nucleus optical model potential and calculate cross sections for reactions (α,α), (α,n), (α,p) and (α,γ) for $8 < Z < 32$.

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 Deliverables:

Continue N-N analysis to energies above 50 MeV and provide evaluated n-p capture cross sections, rates, and uncertainties.

Perform analyses of other processes important to Big Bang nucleosynthesis and provide S-factors and reaction rates. Work on t+α capture will be completed, and cross sections and rates for the ^{7}Li-abundance reactions ^{7}Li(p,α)^{4}He, ^{7}Li(p,n)^{7}Be, and ^{7}Be(n,p)^{7}Li will be updated.

Complete the re-analysis of ^{12}C(α,γ)^{16}O, using an improved description of photon channels in order to determine the extrapolated cross section at astrophysically-relevant energies.

Continue to contribute to the TUNL Energy Levels of Light Nuclei project.

Continue analyses of reactions involving radioactive light isotopes, especially those being measured at the HRIBF in Oak Ridge.

Complete neutron-rich fission barrier calculations (Moller), using new and improved multidimensional macro-micro fission model.

McMaster University – Evaluate hydrogen and helium capture reactions on unstable proton-rich nuclei that are important for energy generation and element synthesis in stellar explosions, with a focus on reactions to be studied at radioactive beam facilities (e.g., TRIUMF-ISAC).

McMaster Deliverables:

Evaluate the reaction rate of radiative proton capture on ^{25}Al and ^{13}N.

Re-evaluate the rates of the ^{21}Na(p,γ)^{22}Mg and ^{18}Ne(α,p)^{21}Na reactions as current experiments progress.

ORNL -- Evaluate capture reactions on radioactive proton-rich nuclei which are important for element synthesis and energy generation in stellar explosions. Develop online software tools for nuclear astrophysics data that process nuclear reaction information.

ORNL Deliverables:

Complete evaluations of proton capture on ^{18}F

Continue assessments of capture reactions on ^{33,34}Cl and ^{30}P

Develop software suite to determine astrophysical reaction rates from cross sections, S-factors, and nuclear structure data

H. Reaction Data for RIA Target Design

Rare Isotope Accelerator facility design needs high-quality nuclear reaction data for target design. LANL will collaborate in order to provide key reaction cross-sections using theory calculations and measurements to evaluate the data.

LANL Deliverables:

Because of insufficient support in our program, we are unable to provide nuclear data for RIA target design in FY05. However, we will continue to maintain a presence in the RIA planning community via participation in RIA meetings and workshops.

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Nuclear Data Activities Funded from Sources Outside the Nuclear Data Program

ANL – Additional support for the ANL Nuclear Data participants comes from an ANL LDRD project related to the development of a gamma-ray tracking detector system.

BNL – Additional support for the nuclear data work at the National Nuclear Data comes from two sources:

1. Academic Press supports the production of computer-generated photo-ready copy of manuscripts for the Nuclear Data Sheets.
2. Consultant services and technical work on neutron cross-section evaluation for fission products and assessment of their current evaluations for the DOE-NNSA Nuclear Criticality Safety program.

Idaho – The group has one subcontract with Idaho State University to compute efficiencies for Ge semiconductor gamma-ray detectors using Monte Carlo methods.

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

1. **Nuclear weapons (ASCI program).** This work supports the development of more accurate ENDF cross section databases for actinide fission fuels, light-nucleus thermonuclear fuels, and for reactions important on 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 are used to validate the ENDF data.

2. **AFCI (Advanced Fuel Cycle Initiative).** This supports the development of improved nuclear data important for transmutation in the fast neutron energy region, as well as high-energy spallation models important for describing processes in the spallation target. Recent focuses have been improved ENDF data on minor actinides (ATW fuel), and lead and bismuth (target/coolant), as well as better intra-nuclear cascade codes for modeling neutron production and radionuclide production in the spallation target. This program also supports experimental nuclear reaction measurements at WNR.

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 are also funded by the program.

4. **RIA R&D.** No recent support.

5. **LANL LDRD.** There are 3 LANL LDRD projects that support nuclear reaction data measurements.

LBNL – Members of the Isotopes Project have always been encouraged to spend a portion of their time working on experiments in the area of low energy nuclear physics. Our Post-doctoral associate will spend 50% of his time working on experiments, primarily at the 88" cyclotron, until that appointment expires half way through the FY. Planned activities include the continuation of the measurement of the half-life of ^{108m}Ag, additional total (n,γ) cross section measurements in collaboration with the Budapest group at the Budapest reactor, and the continuation of neutron activation analysis experiments using a neutron generator at LBNL. Support for these activities is drawn from the DOE low-energy nuclear physics component of our budget.

LLNL – Most of the nuclear data work is supported from funds other than the nuclear data program (roughly 15 FTE). About one-third of this support goes to nuclear data evaluation, nuclear data processing and nuclear data validation. NNSA supports most of the LLNL nuclear data activities (70% of funding). Homeland Security (via NA-22) is a growing component of our funding profile and supports the actinide evaluation work for the Post Detonation Attribution project (20% of funding). A new component of our funding profile is the LDRD for the study of the surrogate reaction technique (10% of funding).

McMaster – The nuclear-structure data effort receives 0.5 FTE support from the Canadian research agency to evaluate A-chains/nuclides for ENSDF and to train/supervise summer students for compilation of experimental data from current papers for XUNDL.

NIST – A variety of sources support nuclear data activities.

1. The Nuclear Data Verification and Standardization program has funding through the Commerce Department (NIST).

2. NIST provides 1 FTE for interferometry work, which has yielded coherent scattering lengths (which provide scattering data) needed for neutron cross section evaluations.

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

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

ORNL –The nuclear data work is partly funded by the Low Energy Nuclear Physics (LENP) program. A new Pilot Program in Nuclear Astrophysics Data has started with LENP funds to hire a postdoc. This effort is tightly coupled with work in experimental and theoretical nuclear astrophysics at ORNL.

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

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USNDP Staffing Table for October 2004 through September 2005

	ANL	BNL		Idaho	LANL	LBNL	LLNL
		Sci/Pro	Support				
I. NNDC Facility Operation	**0.00**	**1.35**	**0.75**	**0.00**	**0.00**	**0.00**	**0.00**
Management		0.35					
Secretarial/Administrative Support			0.50				
Library			0.25				
Computer Operation		1.00					
II. Coordination	**0.03**	**0.50**	**0.00**	**0.00**	**0.40**	**0.30**	**0.00**
National Coordination	0.02	0.35			0.1	0.3	
International Coordination	0.01	0.15			0.3		
III. Nuclear Physics Databases	**0.00**	**1.60**	**1.05**	**0.00**	**0.00**	**0.00**	**0.00**
Nuclear Science References (NSR)		0.10	0.75				
Experimental Nuclear Structure Data (XUNDL)							
Evaluated Nuclear Structure Data (ENSDF)		0.45	0.30				
Numerical Nuclear Data (NuDat)		0.10					
Reaction Data Bibliography (CINDA)		0.20					
Experimental Reaction Data (CSISRS)		0.20					
Evaluated Nuclear Data File (ENDF)		0.30					
Database Software Maintenance		0.05					
Future Database Systems		0.20					
IV. Information Dissemination	**0.02**	**1.45**	**0.50**	**0.00**	**0.10**	**0.25**	**0.00**
Maintenance of Remote Access to USNDP Data		1.00					
Customer Services		0.15	0.45				
Web Site Maintenance	0.02	0.30	0.05		0.10	0.25	

USNDP Staffing Table for October 2004 through September 2005

	McMaster	NIST	ORNL	TUNL		Program Total	
						Sci/Pro	Support
I. NNDC Facility Operation	**0.00**	**0.00**	**0.00**	**0.00**		**1.35**	**0.75**
Management						0.35	0.00
Secretarial/Administrative Support						0.00	0.50
Library						0.00	0.25
Computer Operation						1.00	0.00
II. Coordination	**0.00**	**0.00**	**0.10**	**0.05**		**1.38**	**0.00**
National Coordination			0.1	0.05		0.92	0.00
International Coordination						0.46	0.00
III. Nuclear Physics Databases	**0.00**	**0.00**	**0.00**	**0.00**		**1.60**	**1.05**
Nuclear Science References (NSR)						0.10	0.75
Experimental Nuclear Structure Data (XUNDL)						0.00	0.00
Evaluated Nuclear Structure Data (ENSDF)						0.45	0.30
Numerical Nuclear Data (NuDat)						0.10	0.00
Reaction Data Bibliography (CINDA)						0.20	0.00
Experimental Reaction Data (CSISRS)						0.20	0.00
Evaluated Nuclear Data File (ENDF)						0.30	0.00
Database Software Maintenance						0.05	0.00
Future Database Systems						0.20	0.00
IV. Information Dissemination	**0.00**	**0.00**	**0.05**	**1.20**		**3.07**	**0.50**
Maintenance of Remote Access to USNDP Data						1.00	0.00
Customer Services						0.15	0.45
Web Site Maintenance			0.05	1.20		1.92	0.05

USNDP Staffing Table for October 2004 through September 2005

	ANL	BNL		Idaho	LANL	LBNL	LLNL
		Sci/Pro	Support				
V. Nuclear Structure Physics	**0.70**	**3.40**	**0.00**	**0.50**	**0.10**	**2.63**	**0.00**
NSR Abstract Preparation		0.45					
Compilation of Experimental Structure Data							
Evaluation of Masses and Nuclides for ENSDF	0.65	2.45		0.48		2.30	
Ground and Metastable State Properties		0.15					
Radioactive Decay Data Evaluation	0.05			0.02		0.13	
Thermal Capture Gamma Data Evaluation						0.20	
Light Mass Evaluations for Nuclear Physics A.							
Nuclear Structure Data Measurement					0.10		
ENSDF Physics and Checking Codes		0.35					
VI. Nuclear Reaction Physics	**0.10**	**1.95**	**0.00**	**0.00**	**1.60**	**0.00**	**0.40**
Experimental Data Compilation	0.03	0.30					
Neutron Data	*0.02*	*0.05*					
Charged Particle Data	*0.01*	*0.20*					
EXFOR Manuals		*0.05*					
ENDF Evaluations	0.01	0.90			0.10		0.40
ENDF Manuals and Documentation		0.25					
Nuclear Reaction Standards	0.03				0.20		
Nuclear Model Development	0.02	0.25			0.60		
Nuclear Reaction Data Measurements					0.30		
Astrophysics Nuclear Data Needs	0.01	0.25			0.40		
Reaction Data for RIA Target Design							
DOE/Science Nuclear Data Funded Staff	**0.85**	**10.25**	**2.30**	**0.50**	**2.20**	**3.18**	**0.40**
Staff Supported by Other Funding	**0.15**	**0.25**	**0.20**	**0.20**	**14.40**	**0.55**	**9.75**
TOTAL STAFF	**1.00**	**10.50**	**2.50**	**0.70**	**16.60**	**3.73**	**10.15**

USNDP Staffing Table for October 2004 through September 2005

	McMaster	NIST	ORNL	TUNL		Program Total	
						Sci/Pro	Support
V. Nuclear Structure Physics	**0.50**	**0.00**	**0.55**	**1.00**		**9.38**	**0.00**
NSR Abstract Preparation						0.45	0.00
Compilation of Experimental Structure Data	0.15		0.05			0.20	0.00
Evaluation of Masses and Nuclides for ENSDF	0.35		0.50	0.55		7.28	0.00
Ground and Metastable State Properties						0.15	0.00
Radioactive Decay Data Evaluation						0.20	0.00
Thermal Capture Gamma Data Evaluation						0.20	0.00
Light Mass Evaluations for Nuclear Physics A.				0.45		0.45	0.00
Nuclear Structure Data Measurement						0.10	0.00
ENSDF Physics and Checking Codes						0.35	0.00
VI. Nuclear Reaction Physics	**0.50**	**0.20**	**0.40**	**0.40**		**5.55**	**0.00**
Experimental Data Compilation						0.33	0.00
Neutron Data						*0.07*	*0.00*
Charged Particle Data						*0.21*	*0.00*
EXFOR Manuals						*0.05*	*0.00*
ENDF Evaluations						1.41	0.00
ENDF Manuals and Documentation						0.25	0.00
Nuclear Reaction Standards		0.20				0.43	0.00
Nuclear Model Development				0.40		1.27	0.00
Nuclear Reaction Data Measurements						0.30	0.00
Astrophysics Nuclear Data Needs	0.50		0.40			1.56	0.00
Reaction Data for RIA Target Design						0.00	0.00
DOE/Science Funded Staff	**1.00**	**0.20**	**1.10**	**2.65**		**22.33**	**2.30**
Staff Supported by Other Funding	**0.50**	**0.80**	**3.45**	**0.00**		**30.05**	**0.20**
TOTAL STAFF	**1.50**	**1.00**	**4.55**	**2.65**		**52.38**	**2.50**

APPENDIX A

Argonne National Laboratory

Program Administration

Principal Investigator: Filip G. Kondev
Consultant: Donald L. Smith

Contact: Filip G. Kondev
Nuclear Engineering Division
Argonne National Laboratory
Argonne, IL 60439
Phone: (630) 252 4484
Fax: (630) 252 5287
E-mail: kondev@anl.gov

I. Program Technical Overview

The Argonne Nuclear Data Program includes a variety of scientific activities carried out within the broader framework of the Coordinated Work Plan of U.S. Nuclear Data Program (USNDP). Among these are the compilation and evaluation of nuclear structure and nuclear reaction data, and the development of new methodologies for nuclear data measurement, analysis, and applications. The experimental measurements are carried out at the U.S. Department of Energy national nuclear physics facilities and at leading nuclear laboratories overseas through collaborative arrangements. Attention is paid to collaborative and cooperative opportunities that serve to enhance the effectiveness of the U.S. nuclear physics and nuclear data research activities at minimal cost to the USNDP. The Program emphasizes nuclear structure and decay data and neutron activation data for nuclear model development. Methods for representing data uncertainties, in particular the large uncertainties associated with nuclear data for astrophysics, are explored. Contributions are also made to various specialized nuclear databases serving specific needs in the fields of nuclear structure, nuclear astrophysics, and applied nuclear physics.

II. FY2005 Commitments

1. Coordination (0.03 FTE)

ANL will Chair the Measurements and Basic Physics Committee of the Cross Section Evaluation Working Group and will represent US in the NEA Working Party on Evaluation and Cooperation.

2. Information Dissemination (0.02 FTE)

ANL will continue to develop, update, and maintain the ANL Nuclear Data Measurement Report Series Web site, the ANL Nuclear Data Information Web site and the Experimental Resources for Nuclear Data Web site.

3. Nuclear Structure Physics (0.70 FTE)

ANL will continue to contribute to the activities of the International Nuclear Structure and Decay Data Network by compiling and evaluating data for selected mass chains and individual nuclides. During FY2005 we plan to complete evaluations for one mass chain from the region assigned to ANL, including some nuclides that are on the NNDC priority list. Review of selected evaluations, submitted by members of NSDD network for publication, will be also performed, as requested. Contributions to the Decay Data Evaluation Project (DDEP) activities will continue. It is planned to submit one decay dataset to the DDEP Chairman. A special (horizontal) evaluation of properties of nuclear K-isomers will also continue in collaboration with physicist from Australia, UK and Bulgaria. It is envisioned to continue activities in the area of experimental nuclear physics related to the need of nuclear data, particularly in the areas of nuclear structure and decay, and RIA issues. The experimental work will be carried out at ANL, as well as at other national low-energy nuclear physics facilities, at little or no cost to the Argonne nuclear data participant. The results of this work will be documented in journal articles and laboratory reports. These will be also made available to the members of the NSDD network for inclusion in ENSDF.

4. Nuclear Reaction Physics (0.10 FTE)

Argonne will continue to collaborate with IRMM, Geel, Belgium, and its subcontracted laboratories in Eastern Europe (Bulgaria, Romania, and Hungary) in the area of neutron activation cross sections. ANL will contribute by assisting in the preparation of manuscripts for journal publications and by compiling, in the EXFOR format, those experimental data acquired in this program as the final results become available. ANL will also participate in the analysis of neutron spectrum data for deuterons on metal-backed tritium targets at energies above 2 MeV. These data were measured at Ohio University in an ANL-IRMM-Ohio collaboration. ANL is also involved in an international activity to produce a new neutron standards file. This project is being coordinated by the IAEA, and it involves participating laboratories from the U.S., Europe, Russia, and Asia. The goal is to generate a final version of this file by the end of CY2004, in time for inclusion in ENDF/B-VII. The main contribution by ANL to this project is in the area of evaluation methodology. ANL is also leading an NEA-sponsored program to develop an improved on-line nuclear data request list system. ANL will be a participant in the WPEC permanent Subgroup C that will oversee this project. Finally, ANL is collaborating with ORNL in a project to develop advanced methods for performing nucleosynthesis calculations by means of Monte Carlo simulation. This work will entail inclusion of nuclear reaction rates important for such calculations as well as corresponding error files. ANL's contribution lies in the area of data uncertainty representation and the development of methodologies for error propagation in these complex calculations.

APPENDIX B

Idaho Evaluators

R.G. Helmer and C.W. Reich

		FTE
Evaluation responsibilities: masses 87, 153-163		
Two equivalent mass chains will be evaluated.		0.43
Two mass chains will be reviewed.		0.05
Decay Data Evaluation Project		
Decay data for 3 nuclides will be evaluated.		0.02
	Total	0.50

APPENDIX C

Isotopes Project
Lawrence Berkeley National Laboratory

NUCLEAR STRUCTURE AND DECAY DATA EVALUATION

The Isotopes Project's plans for FY2005 include a mix of individual nuclide and entire mass chain evaluations chosen from those for which LBNL has been assigned responsibility. The former are particularly effective in enabling the prompt inclusion in ENSDF of major new data for nuclides on which current research activities are centered. The latter, however, provide a comprehensive view of the nuclear systematics of isobars. Also, Isotopes Project personnel will participate in the review of other data evaluations submitted to NNDC. Isotopes Project personnel will continue to play a leadership role in the Decay Data Evaluation Project (DDEP), an international collaboration addressing current applied and research community needs.

The planned level of effort for data evaluation activities is 2.63 FTE: 2.33 FTE from LBNL employees (which includes 0.50 FTE from an appointment yet to be approved and funded) plus 0.30 FTE from visiting evaluators.

- **Mass Chain and Nuclide Evaluation:**
  At least 4 mass chain equivalents chosen from regions for which LBNL is responsible (including at least one from the A=21-30 region and one from the A>212 region).
- **Mass Chain Reviews:**
  Provide reviews of mass chains as requested.
- **New Evaluator Training and Mentoring:**
  Continue mentoring of new evaluators and provide lecturer(s) for IAEA/ICTP evaluator training workshops, as needed.

Effort for above items: 2.30 FTE (which includes 0.3 FTE from visitors)

- **Decay Data Evaluation Project (DDEP): Nuclear and Atomic Radiations:**
  - Coordinate and plan activities of this international collaboration
  - Review evaluations of ~5 radionuclides.
  - Submit decay datasets for one radionuclide.

Effort: 0.13 FTE

- **(n,γ) data evaluation**
  - As new measurements from the Budapest Reactor become available, they will be evaluated and added to the "Prompt Gamma Activation File" (EGAF) database that

resulted from a recent IAEA CRP in which LBNL was involved. Total capture cross sections will also be extracted from those data when possible and the revised evaluations will be made available for use in other relevant databases.

- In collaboration with LLNL, data from the EGAF database will be used to update the capture gamma-ray production information in the ENDF/B database and statistical calculations will be performed to provide quasi-continuum gamma-ray information to augment the discrete gamma-ray information available from EGAF. The results of these statistical calculations will also be used to refine the EGAF database.

Effort: 0.20 FTE

NUCLEAR DATA DISSEMINATION

We will continue our nuclear data dissemination efforts with a view to providing scientists and engineers throughout the world with user-friendly means to access the wide variety of evaluated and compiled nuclear data. This work will be done with an LBNL staff effort of 0.25 FTE**.**

- **WWW Home Pages**

Home pages for neutron-capture gamma rays, nuclear structure and decay systematics, nuclear science education, atomic masses, and other topics will be updated and maintained as needed.

- **Software Support**

Support will be provided for *Isotope Explorer* and NSR search software developed by LBNL.

Effort: 0.25 FTE

EXPERIMENTAL ACTIVITIES

Members of the Isotopes Project have always been encouraged to spend a portion of their time working on experiments in the area of low energy nuclear physics, with emphasis on experiments related to the needs of nuclear data and nuclear astrophysics. Our Post-doctoral associate will spend 50% of his time working on experiments, primarily at the 88" cyclotron, until that appointment expires half way through the FY. Planned activities include the continuation of a measurement of the half-life of ^{108m}Ag, additional total (n,γ) cross section measurements in collaboration with researchers at the Budapest reactor, and the continuation of neutron activation analysis experiments using a neutron generator at LBNL.

These activities are supported from the DOE Low-energy Nuclear Physics component of our budget.

Effort: 0.55 FTE

MANAGEMENT AND NATIONAL COORDINATION

The group leader of the Isotopes Project serves as a member of the USNDP Coordinating Committee and chairs the USNDP Nuclear Structure and Decay 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.

Effort: 0.3 FTE

APPENDIX D

Lawrence Livermore National Laboratory

II. Coordination

A. National Coordination

LLNL – Traditionally LLNL has not been fully integrated into the national nuclear data community in that our evaluations are all produced in LLNL's internal ENDL format. The differences between the ENDL and ENDFB/6 formats create an artificial barrier to the transmission of evaluations between LLNL and the national community. In FY04, the Computational Nuclear Physics group completed a beta version of the `fete` code. This code translates ENDFB/6 formatted data into the ENDL format. In FY05 we plan to complete the reverse process so that LLNL evaluations can flow back into the nuclear data community.

LLNL Deliverables:

Develop code to translate data in the internal LLNL format to the international standard ENDFB/6 (or 7) format. *(0.1 FTE)*

Release the `fete` translation code.

IV. Information Dissemination

C. Web Site Maintenance

LLNL -- LLNL's Computational Nuclear Physics group provides web-based access to the evaluated and processed nuclear and atomic data that it manages.

LLNL Deliverables:

Maintain LLNL's Nuclear and Atomic Data Viewer.

Extend the Nuclear and Atomic Data Viewer to handle other data formats (esp. Monte Carlo data).

Maintain and upgrade LLNL's Computational Nuclear Physics web pages.

VI. Nuclear Reaction Physics

B. ENDF Evaluations *(0.2 FTE)*

LLNL -- The Institute of Isotope and Surface Chemistry, Budapest has recently undertaken an extensive set of elemental measurements of capture gamma-ray energies and intensities as part of an IAEA CRP on "Development of a Database for Prompt Gamma-ray Neutron Activation Analysis (PGAA)," led by LBNL. The evaluated tables of prompt and delayed gamma-ray yields developed by this activity, called the Evaluated Gamma-ray Activation File (EGAF), is a significant improvement over previous work. We propose to collaborate further

with LBNL to develop a set of ENDF files to be used to update the capture gamma-ray production information in the ENDF/B database. The availability of this data in coupled neutron-photon transport codes is very important to several national security programs, and this project is leveraged by funding from those programs.

LLNL Deliverables:

Providing peer review of the draft EGAF database

Simulating the gamma-ray cascade from resonance capture in order to add information on the quasi-continuum of gamma rays for A = 40 nuclei where level spacings become comparable to detector resolution. This information is usually not available experimentally because the targets used were not typically mono-isotopic.

Extend the data files up to approximately En = 100 keV based on the results of the simulations

Producing ENDF files with the discrete and quasi-continuum gamma-ray spectra

VI. Nuclear Reaction Physics

B. ENDF Evaluations *(0.1 FTE)*

LLNL Deliverables: (work mostly supported from other sources)

Submit new improved evaluations for neutron induced reactions on nuclei in the A=43-56, 74-83, and 123-158 mass regions.

Review state of actinide evaluations and make improvements based on study of systematics in this mass range for DNEA program.

E. Nuclear Model Development

LLNL -- An innovative technique for determining nuclear reaction rates indirectly via surrogate nuclear reactions is currently being explored at LLNL. The surrogate reactions approach potentially enables a host of experimental measurements on unstable nuclei which would otherwise remain unmeasured, including several critical for SBSS and astrophysical applications. The surrogate reaction mechanism is conceptually simple. Suppose we need the cross section for the reaction $a + A \rightarrow B^* \rightarrow c + C$, where a and A are projectile and target, and c and C are reaction products. We assume that the reaction proceeds through a well-defined compound nucleus, indicated by B^*. Direct measurement is impossible when A is an unstable or excited nucleus (relevant to radiochemistry for SBSS), or when the reaction is inhibited by a high Coulomb barrier between a and A (such as in astrophysical processes involving low-energy charged particles). In the surrogate method, the compound nucleus is produced by an initial reaction $d + D \rightarrow b + B^*$ using a stable target D. Intensities, energies, and emission angles of the decay products of B^* into the channels $a + A$ and $c + C$ are measured in coincidence with the outgoing particle b from the initial reaction. From this information the cross section for the desired reaction can in principle be estimated from well-known models for compound nuclear reactions.

LLNL Deliverables:

Address the difference in angular-momentum transfer between a surrogate reaction and more direct approaches.

Carry out a feasibility study of using the surrogate technique to estimate (p,γ) reactions on unstable nuclei in the A=60 to 90 mass range.

Add ability to model decay probabilities for surrogate reaction studies to MOARC or other reaction model.

F. Nuclear Reaction Data Measurements

LLNL – Nuclear data for reactions on unstable targets are important for a variety of applied and basic scientific applications. LLNL, in collaboration with Academic Alliance and LANL collaborators, will perform neutron reaction measurements on isomers and on unstable actinides using the surrogate technique. The surrogate work will be performed in conjunction with the theory effort in section IV.E

LLNL Deliverables:

Neutron induced reaction measurements on one or more isomer targets.

Perform surrogate (n,n'), (n,2n), (n,γ) and (n,f) measurements on several nuclei with programmatic and/or astrophysical importance.

Nuclear Data Activities Funded from Sources Outside the Nuclear Data Program

LLNL – Most of the nuclear data work is supported from funds other than the nuclear data program (roughly 15 FTE). About one-third of this support goes to nuclear data evaluation, nuclear data processing and nuclear data validation. About one-third also goes to both nuclear experiments and nuclear theory/modeling development. NNSA supports most of the LLNL nuclear data activities (70% of funding). Homeland Security (via NA-22) is a growing component of our funding profile and supports the actinide evaluation work for the Post Detonation Attribution project (20% of funding). A new component of our funding profile is the LDRD for the study of the surrogate reaction technique (10% of funding).

APPENDIX E

Nuclear Data Group
McMaster University

(Submitted by B. Singh and A. Chen, February 10, 2004)

Nuclear Structure Physics (B. Singh): Evaluation and compilation of Nuclear Structure mass chain evaluations are also published in Nuclear Data Sheets journal.

Compilation of Experimental Structure Data: **(0.15 FTE)**

Compilation of currently published or completed experimental nuclear structure data for inclusion in the XUNDL database.

McMaster Deliverables (FY05):

Compile data sets (in ENSDF format) of current publications with emphasis on high-spin physics, but selected low-spin and decay data publications will also be compiled.

Compile, on a time available basis, high-spin data from older publications not yet incorporated in outdated ENSDF evaluations

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. On an annual basis send a copy of all such private communications to NNDC for archival and distribution purpose.

Data Evaluation for ENSDF database: **(0.35 FTE)**

McMaster Deliverables (FY05):

1.5 equivalent mass chains (including some in the A=31-44 region) will be evaluated.

Mass chains will be reviewed as requested.

Update superdeformed-band data in ENSDF. All nuclides will be covered that do not require a complete re-evaluation.

Nuclear Reaction Physics (A. Chen):

Evaluation of Data Needed for Astrophysics: The goal of this program is to evaluate reactions of importance in stellar explosions, focusing on ones that will be measured at radioactive beam facilities. The McMaster group is heavily involved with the research program at TRIUMF-ISAC, where some of these reactions will be studied. The data project involves complete evaluations of radiative proton capture on ^{21}Na, ^{13}N, ^{25}Al, ^{26}Al$_g$, and ^{19}Ne. **(0.5 FTE)**

McMaster Deliverables (FY05):

Evaluate the reaction rate of radiative proton capture on ^{25}Al and ^{13}N.
Re-evaluate the rates of the ^{21}Na(p,γ) ^{22}Mg and ^{18}Ne(α,p) ^{21}Na reactions as current experiments progress.

FUNDING:

DOE supported staff: 0.5 FTE for structure data evaluation, and
0.5 FTE for astrophysics data evaluation.
Other funding: 0.5 FTE for structure data evaluation (from Canadian research agency).

APPENDIX F

Nuclear Data Verification and Standardization Program
National Institute of Standards and Technology

REACTION ACTIVITIES: Perform the duties, which will lead to an international evaluation of the neutron cross section standards. Chair the activities of the IAEA Coordinated Research Program (CRP) on the Improvement of the Standard Cross Sections. Complete the examination of inconsistent (discrepant) data in the experimental database that will be used for the evaluation. Add remaining data from experiments to be used in the evaluation to the database. Work with the CRP to perform a comprehensive standards evaluation. Act as Coordinator of the activities of the NEANSC's Working Party on International Evaluation Cooperation (WPEC) Subgroup, which promotes international cooperation on measurements and evaluations of the nuclear data standards. This Subgroup has been most helpful in providing experimental work to improve the database for the standards evaluation. This standards evaluation activity is done under the auspices of the U.S. CSEWG, the NEANSC, and the IAEA, and has included participants from Austria, Belgium, China, France, Germany, Japan, the Republic of Korea, Russia and the USA.

Suggest, motivate and monitor measurements, with an emphasis on measurements related to the $^{10}B(n,\alpha)$ cross section, for use in future standards evaluations, largely through the NEANSC's WPEC. Such activities will continue to be encouraged however they cannot be used for the present international evaluation of the standards. Continue the NIST-Ohio University-LANL collaboration with plans to improve the hydrogen scattering angular distribution. In order to effectively motivate and monitor standards experiments, which are needed for standards evaluations, NIST has been and will be an active participant in a number of experiments. Coordinate CSEWG standards activities. Participate in CSEWG meetings. Provide neutron cross-section standards and uncertainty information for use in the ENDF/B-VII library. Participate in USNDP Coordinating Committee meetings. Maintain the National Repository for Fissionable Isotope Mass Standards.

DISSEMINATION ACTIVITIES: Make presentations at informal meetings on standards activities.

(total of 0.2 FTE of support from the DOE)

OTHER: NIST and the Contractor Carlson provide approximately a 0.8 FTE of support for these standards activities. Independent of the verification and standards program, there is approximately 1 FTE NIST support for nuclear structure and decay studies, and also approximately 1 FTE of NIST support for interferometry and low energy cross section work related to the standards.

APPENDIX G

Nuclear Data Project
Oak Ridge National Laboratory

II. Coordination

A. National Coordination

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 Deliverables:

Summarize USNDP efforts in nuclear data for nuclear astrophysics at USNDP Meeting in November 2004

Summarize USNDP efforts in nuclear data for nuclear astrophysics in FY03 and FY04 for USNDP written reports

Communicate current efforts and future plans with researchers in nuclear astrophysics data

Discuss future plans in nuclear astrophysics data with USNDP/NNDC and DOE

IV. Information Dissemination

C. Web Site Maintenance

USNDP members who offer information through a web site require resources to maintain currency and improve performance. All sites will coordinate their effort and implement a "USNDP approved site" program with an appropriate identifier.

ORNL Deliverables:

Continue to maintain, update, and improve the WWW/FTP site providing the RadWare interface to ENSDF and XUNDL data sets

Begin porting the RadWare-to-ENSDF conversion program for use in Microsoft Windows

Investigate the development of a Microsoft Windows application for displaying and editing RadWare level schemes, as a helper application for WWW browsers

Develop online software suite to convert nuclear data to astrophysical reaction rates and plot, manipulate, and share results online

V. Nuclear Structure Physics

B. Compilation of Experimental Structure Data

Compilation of currently published or completed experimental nuclear structure data (primarily high-spin) for inclusion in XUNDL.

ORNL Deliverables:

Improve software for converting tabular/graphic published level-scheme data in journals and unpublished data supplied by researchers to Radware database into ENSDF format.

Finish debugging code that was recently ported from Fortran to C.

C. Data Evaluation for ENSDF

The USNDP evaluates nuclide and mass chain nuclear structure and decay data for inclusion in the ENSDF database. LBNL hired a physicist in April 2003 for a 2 year postdoctoral appointment, allowing roughly equal time for nuclear structure and decay data evaluation and for experimental work (initially astrophysics-related experiments at the 88" cyclotron).

ORNL Deliverables:

Complete evaluation of structure information for nuclei with A=243

Evaluate structure information for A=233 nuclei

Start evaluation of A=229 nuclei

Train one new evaluator

VI. Nuclear Reaction Physics

G. Evaluation of Data Needed for Astrophysics

The objective of this activity is to support the nuclear data needs of increasingly sophisticated astrophysics simulation computer codes. The Astrophysics Task Force of the USNDP, presently chaired by Michael Smith (ORNL) plans, initiates and implements cooperative nuclear data evaluation activities involving both the nuclear data and the nuclear astrophysics communities, and serves to improve communication between different evaluators as well as between evaluators and astrophysics modelers.

ORNL -- Evaluate capture reactions on radioactive proton-rich nuclei which are important for element synthesis and energy generation in stellar explosions. Develop online software tools for nuclear astrophysics data that process nuclear reaction information.

ORNL Deliverables:

Complete evaluations of proton capture on ^{18}F

Continue assessments of capture reactions on ^{33,34}Cl and ^{30}P

Develop software suite to determine astrophysical reaction rates from cross sections, S-factors, and nuclear structure data

APPENDIX H

Triangle Universities Nuclear Laboratory

NUCLEAR DATA EVALUATION PROJECT

A = 3 – 20

J.H. Kelley, J. L. Godwin, J.E. Purcell, G. Sheu, H.R. Weller

COORDINATION Total FTE: 0.05

Report preparation and coordination for ad-hoc task force on "The Impact of Nuclear Data on Society"

NUCLEAR STRUCTURE Total FTE: 1.0

EVALUATIONS: (0.55 FTE evaluation of levels for ENSDF)
(0.45 FTE evaluation for other published literature: including nuclear reaction information published in Energy Levels of Light Nuclei manuscripts, and information published on our website.)

Evaluate and distribute preliminary review of A = 12 nuclides for comments.
Prepare *"Energy Levels of Light Nuclei, A* = 11 - 12*"* for publication in *Nuclear Physics A.*
Prepare evaluation of A = 3 nuclides for publication in *Nuclear Physics A.*
Begin evaluation of A = 13 nuclei and prepare preliminary report to be distributed for comment.

ENSDF:

Prepare and submit ENSDF file for A=3 nuclei.
Prepare the ENSDF files for A = 11-12 nuclei corresponding with the *Nuclear Physics A* publication.

DISSEMINATION Total FTE 1.2

TUNL Nuclear Data Evaluation Project Website:

Continue to prepare new PDF and HTML documents of the most recent TUNL reviews of A = 11 and 12 (publication versions), and A = 3 and 12

(preliminary versions). PDF and HTML documents are currently available for TUNL and FAS publications for the years 1968-present.

Continue to provide PDF and HTML documents for older FAS reviews for the A = 3 - 20 series; provide new PDF and HTML documents for A = 5 - 10 (66LA04) and A = 5 - 20 (56AJ76).

Modify and create new HTML documents for the website to incorporate both Netscape and Internet Explorer browser HTML code functionality and compatibility.

Continue to provide General Tables to accompany the most recent TUNL reviews of the A = 3 - 20 series; General Tables for A = 3 and 12 to be completed to correspond to preliminary reports; update A = 11 and 12 General Tables to correspond to the review published in *Nuclear Physics A.*

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.

PROGRAM ON PREEQUILIBRIUM PHENOMENOLOGY

Constance Kalbach Walker

NUCLEAR REACTIONS Total FTE 0.4

MODEL AND CODE DEVELOPMENT:

Program Overview:

Development of preequilibrium nuclear reaction models with a global input parameter set; improvement and benchmarking of the computer code PRECO which embodies these models. Once released, the code modules are used alone or in Hauser-Feshbach codes such as GNASH. The goal is to achieve a predictive tool for continuum reactions at 14 to 200 MeV.

Recent Accomplishments:

Publication of work on surface localization of initial interactions by incident neutrons (PRC, Jan 2004).

Completion of major work on reactions involving complex particle channels. Journal article nearing completion.

FY2005 Plans:

Specific work to be undertaken in FY2005 is difficult to predict, because this is basic research. Thus the amount of effort required for individual tasks is hard to predict and the flow of work is influenced by the availability of new data in the

literature as well as by input from scientists using the models in PRECO. Preparation for the next release of PRECO with its users manual should be completed, with the code being sent to the distribution centers at BNL and ORNL. Then work on extending model verification (and, where necessary, modification) and code benchmarking for (N,N) reactions to higher incident energies can begin. This involves studying the incident energy dependence of the matrix elements for the residual interactions causing nuclear energy equilibration. Other tasks may be substituted based on new data, user input, or unexpected complexities in current tasks.

FY2005 Deliverables:
New release of PRECO and its users manual.
An expanded dataset of spectra for (N,N) reactions at incident energies of 40 to 100 MeV or higher.
Possible revisions to the models and/or global input set and thus to the code.