

**DEPARTMENT OF ENERGY
OFFICE OF SCIENCE, NUCLEAR PHYSICS
OFFICE OF SCIENCE, NUCLEAR PHYSICS, ISOTOPES PROGRAM
OFFICE OF NUCLEAR ENERGY
NATIONAL NUCLEAR SECURITY ADMINISTRATION, OFFICE OF
DEFENSE NUCLEAR NONPROLIFERATION R&D**



**NUCLEAR DATA INTERAGENCY WORKING GROUP /
RESEARCH PROGRAM**

**DOE NATIONAL LABORATORY PROGRAM ANNOUNCEMENT NUMBER:
LAB 19-2114**

ANNOUNCEMENT TYPE: INITIAL

Announcement Issue Date:	04/19/2019
Submission Deadline for Letter of Intent:	05/15/2019 at 5 PM Eastern Time (A Letter of Intent is required)
Proposal Encourage Date:	06/1/2019 at 5 PM Eastern Time
Submission Deadline for Proposals:	06/28/2019 at 5 PM Eastern Time

Table of Contents

REGISTRATIONS	I
UPDATES AND REMINDERS.....	III
SECTION I – DOE NATIONAL LABORATORY OPPORTUNITY DESCRIPTION	1
SECTION II – AWARD INFORMATION.....	11
A. TYPE OF AWARD INSTRUMENT.....	11
B. ESTIMATED FUNDING	11
C. MAXIMUM AND MINIMUM AWARD SIZE.....	11
D. EXPECTED NUMBER OF AWARDS.....	11
E. ANTICIPATED AWARD SIZE	12
F. PERIOD OF PERFORMANCE	12
G. TYPE OF PROPOSAL	12
SECTION III – ELIGIBILITY INFORMATION	13
A. ELIGIBLE APPLICANTS AND TOPICS.....	13
B. COST SHARING.....	13
C. ELIGIBLE INDIVIDUALS.....	13
SECTION IV – PROPOSAL AND SUBMISSION INFORMATION	14
A. ADDRESS TO REQUEST PROPOSAL PACKAGE.....	14
B. LETTER OF INTENT AND PRE-PROPOSAL.....	14
C. CONTENT AND PROPOSAL FORMS	16
LETTERS OF SUPPORT SHOULD NOT BE INCLUDED IN THE APPLICATION.	17
D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS.....	29
E. SUBMISSION DATES AND TIMES	29
F. FUNDING RESTRICTIONS.....	30
G. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS	30
SECTION V - PROPOSAL REVIEW INFORMATION	32
A. CRITERIA	32
B. REVIEW AND SELECTION PROCESS	33
C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES.....	34
SECTION VI - AWARD ADMINISTRATION INFORMATION	35
A. AWARD NOTICES.....	35
B. REPORTING	35
SECTION VII - QUESTIONS/AGENCY CONTACTS.....	36

A. QUESTIONS	36
B. AGENCY CONTACTS	36
SECTION VIII - OTHER INFORMATION	38
A. MODIFICATIONS	38
B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE.....	38
C. COMMITMENT OF PUBLIC FUNDS.....	38
D. PROPRIETARY PROPOSAL INFORMATION.....	38
E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL.....	38
F. AVAILABILITY OF FUNDS.....	39
SECTION IX - APPENDICES/REFERENCE MATERIAL	40
APPENDIX A: 2019 NUCLEAR DATA NEEDS LIST FOR ISOTOPE PRODUCTION	40

REGISTRATIONS

A. DOE Office of Science Portfolio Analysis and Management System (PAMS)

The Department of Energy (DOE) Office of Science (SC) performs many functions for DOE national laboratory proposals in the Portfolio Analysis and Management System (PAMS), which is available at <https://pamspublic.science.energy.gov>.

You must register in PAMS to submit a pre-proposal, letter of intent, or DOE national laboratory proposal.

To access PAMS, you may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers.

Notifications sent from the PAMS system will come from the PAMS email address <PAMS.Autoreply@science.doe.gov>. Please make sure your email server/software allows delivery of emails from the PAMS email address to yours.

Registering to PAMS is a two-step process; once you create an individual account, you must associate yourself with (“register to”) your institution. Detailed steps are listed below.

1. CREATE PAMS ACCOUNT:

To register, click the “Create New PAMS Account” link on the website <https://pamspublic.science.energy.gov/>.

- Click the “No, I have never had an account” link and then the “Create Account” button.
- You will be prompted to enter your name and email address, create a username and password, and select a security question and answer. Once you have done this, click the “Save and Continue” button.
- On the next page, enter the required information (at least one phone number and your mailing address) and any optional information you wish to provide (e.g., FAX number, website, mailstop code, additional email addresses or phone numbers, Division/Department). Click the “Create Account” button.
- Read the user agreement and click the “Accept” button to indicate that you understand your responsibilities and agree to comply with the rules of behavior for PAMS.
- PAMS will take you the “Having Trouble Logging In?” page. (Note: If you reviewed for or were listed as PI on a prior submission to SC but have not previously created an account, you may already be linked to an institution in PAMS. If this is the case, PAMS will take you to the PAMS home page.)

2. REGISTER TO YOUR INSTITUTION:

- Click the link labeled “Option 2: I know my institution and I am here to register to the institution.” (Note: If you previously created a PAMS account but did not register to an

institution at that time, you must click the Institutions tab and click the “Register to Institution” link.)

- PAMS will take you to the “Register to Institution” page.
- Type a word or phrase from your institution name in the field labeled, “Institution Name like,” choose the radio button next to the item that best describes your role in the system, and click the “Search” button. A “like” search in PAMS returns results that contain the word or phrase you enter; you need not enter the exact name of the institution, but you should enter a word or phrase contained within the institution name. (Hint: If your institution has an acronym, such as ANL for Argonne National Laboratory or UCLA for the Regents of the University of California, Los Angeles, you may search for the acronym under “Institution Name like.” Many institutions with acronyms are listed in PAMS with their acronyms in parentheses after their names.)
- Find your institution in the list that is returned by the search and click the “Actions” link in the Options column next to the institution name to obtain a dropdown list. Select “Add me to this institution” from the dropdown. PAMS will take you to the “Institutions – List” page.
- If you do not see your institution in the initial search results, you can search again by clicking the “Cancel” button, clicking the Option 2 link, and repeating the search.
- All DOE National Laboratories have established profiles in PAMS, so please keep searching until you find your laboratory.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submissions and inquiries about this DOE National Laboratory Announcement should reference **LAB 19-2114**.

UPDATES AND REMINDERS

RECOMMENDATION

The Department of Energy (DOE) Office of Science (SC) encourages you to register in all systems as soon as possible. You are also encouraged to submit letters of intent and proposals well before the deadline.

DATA MANAGEMENT PLAN

The Office of Science Statement on Digital Data Management, published at <http://science.energy.gov/funding-opportunities/digital-data-management/>, governs applications submitted under this Announcement. Compliance is detailed in Section IV of this Announcement.

ACKNOWLEDGMENT OF FEDERAL SUPPORT

SC published guidance about how its support should be acknowledged at <http://science.energy.gov/funding-opportunities/acknowledgements/>.

AVOIDING ERRORS

The following advice is compiled from actual experiences of applicants for SC awards.

- Please ensure that the research narrative is comprised of one and only one Portable Document Format (PDF) file, including all appendices, when it is uploaded.
- When using the PAMS website at <https://pamspublic.science.energy.gov>, please avoid using the back-arrow button in your web browser to navigate.
- Please ensure that the proposal contains no personally identifiable information (PII).
- Please ensure that the budget is calculated using the applicable negotiated indirect cost and fringe benefit rates.

Section I – DOE NATIONAL LABORATORY OPPORTUNITY DESCRIPTION

GENERAL INQUIRIES ABOUT THIS ANNOUNCEMENT SHOULD BE DIRECTED TO:

Technical/Scientific Program Contacts:

DOE Office of Nuclear Physics, and general information:

Dr. Timothy Hallman, Office of Nuclear Physics
Associated Director, Office of Nuclear Physics
301-903-3613

timothy.hallman@science.doe.gov

DOE Isotope Program:

Dr. Ethan Balkin, Office of Nuclear Physics, DOE Isotope Program
Program Manager, Isotope R&D
301-903-1861

Ethan.Balkin@science.doe.gov

DOE Office of Nuclear Energy:

Mr. David Henderson, Office of Nuclear Energy
Program Manager, Advanced Modeling and Simulation
301-903-9991

david.henderson@nuclear.energy.gov

NNSA Defense Nuclear Nonproliferation R&D:

Dr. Donald Hornback, Office of Defense Nuclear Nonproliferation R&D
Program Manager, Near-field Detection
202-586-6522

donald.hornback@nnsa.doe.gov

SUMMARY

The DOE SC program in Nuclear Physics (NP), the NP Isotopes Program (IP), the DOE Office of Nuclear Energy (NE) and the DOE National Nuclear Security Administration (NNSA) Office of Defense Nuclear Nonproliferation Research and Development (NA-22) hereby announce their interest in receiving applications to the Nuclear Data Interagency Working Group / Research program for research projects intended to answer nuclear data questions of interest to the research communities supported by those programs and offices.

SUPPLEMENTARY INFORMATION

Program Objective

The range of nuclear physics has a broad range of uses in modern society. Notable examples include fundamental research in nuclear physics, which motivates the development of accelerator

technology, high-speed electronics, and special materials for sensitive detectors and targets; nuclear reactors, which have applications including the generation of electrical power, the production of isotopes, and tests of the properties of materials using neutrons; national security and nonproliferation applications, such as safeguards, nuclear forensics, and the detection of special nuclear materials (SNM); nuclear medicine, and the associated production, testing, distribution and use of isotopes in medical diagnostics and treatment; and applications to more familiar industrial problems, such as the use of radioisotopes in geological resource surveys. This Announcement seeks research proposals that will enhance understanding of the basic characteristics of isotopes without respect to particular uses.

These applications require accurate quantitative information regarding the properties of nuclei and their interactions with matter and radiation. In reference to the applications cited above, without the appropriate nuclear data, the accurate simulation and design of experiments for fundamental research would not be possible, nuclear reactor design and operation would suffer from problematic uncertainties, it would not be possible to determine the correct dose levels in medical procedures involving nuclear isotopes, and one could not predict the sensitivity of novel remote sensing techniques.

Extensive databases dedicated to nuclear data do already exist, notably those developed and maintained by the DOE Office of Nuclear Physics (NP) through the US Nuclear Data Program (USNDP) at Brookhaven National Laboratory (BNL). However, a critical examination of the existing nuclear data often finds that it is inadequate for current applications. This may be due for example to limits on the sensitivity of experiments that were carried out in previous decades, studies that accessed only a few experimental parameters (such as limited beam energies or angular coverage), or attempts to constrain a large number of parameters with limited data. One may also require information about the nuclear properties of materials that simply did not exist previously, or that were never adequately studied under conditions that are now considered important.

From the viewpoint of NP, this Announcement was originally motivated by the 2014 USNDP Review, which confirmed that experimental efforts to address gaps in nuclear data are within the scope of the USNDP program. This is expressed in the updated USNDP Mission Statement, which states that

“The mission of the United States Nuclear Data Program (USNDP) is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. The USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models.”

This identification of an experimental role for the USNDP was followed by NP-sponsored reviews of nuclear data needs that could be addressed through such an experimental program, both for applications [1] and for basic research [2].

Accordingly, the purpose of the research program associated with this Announcement is to support new activities (*e.g.* experiments, infrastructure, models, and so forth) that will provide

new nuclear data or related predictions where needed in areas in which the existing data is inadequate or does not exist, and insure that the new data is transferred to the appropriate nuclear databases in a timely manner.

One challenge with updating our nuclear data through new experiments is that these experiments can be quite demanding on the limited resources available for this type of use-inspired research. Fortunately, recent “Nuclear Data Needs” reviews [1,2] show that there are often similar data needs associated with different applications, so there can be considerable economic benefit in different federal offices jointly supporting a given set of new nuclear data measurements. This advantage of a combined measurement program was the original motivation for the formation of the Nuclear Data Interagency Working Group (NDIAWG), and is the primary motivation for this Announcement.

This Announcement invites researchers to submit proposals for new nuclear data activities, ideally after discussions with the appropriate Program Managers listed at the beginning of this Section under Technical/Scientific Program Contacts. As discussed elsewhere in this Announcement, proposals will be reviewed by NP, using reviewers proposed by the interested Offices or Agencies. Following a successful review, the interested Offices or Agencies will discuss the proposal with the PI, and will endeavor to provide suitable funding for the components of the proposed work that they wish to support.

Since this Announcement is intended to address gaps in our databases in a timely manner, funds may be requested within each application to support a named USNDP staff member, the “USNDP POC,” who will be associated with the experiment or other activity, and will be responsible for incorporating the new data, results, or procedures in the USNDP program. USNDP personnel at DOE/NNSA National Laboratories may be proposed, but personnel at academic institutions may be proposed as subawardees or consultants.

Data generated from authorizations under this Announcement must be made publicly available through the USNDP databases. Submission of data to the USNDP databases does not confer Government ownership of the data.

Nuclear Data Questions by Office

In the following section, principal areas and topics in which each of the participating Offices perceives a public benefit for improved nuclear data are described. Potential PIs are encouraged to review this section when preparing their applications and to discuss topics of interest with the relevant Program Managers. In this manner, the PIs may be able to identify “cross-cutting” nuclear data needs that could increase the probability of attracting support from multiple Offices. The Offices, their associated Program Managers, and descriptions of the specific nuclear data questions are listed below.

DOE SC NP

Dr. Timothy Hallman (timothy.hallman@science.doe.gov)

NP has two general goals in this Announcement:

1) To improve the effectiveness of USNDP databases in addressing the needs of the broad community of nuclear data users, and

2) To address nuclear data needs of special interest to NP researchers.

Regarding part 1), NP would anticipate supporting activities that increase the efficiency of the “Nuclear Data Pipeline,” for example through the incorporation of improved computational techniques and procedures USNDP evaluations; assisting in the identification of the most important data needs in the USNDP databases; supporting experimental activities to address these needs; assisting with the publication of new nuclear data, and the transfer to and dissemination from the appropriate USNDP archive(s). These activities will likely require the participation of USNDP through a USND point of contact (POC). Timothy Hallman, DOE-NP Associate Director and Acting NP Program Manager for Nuclear Data (timothy.hallman@science.doe.gov) is available to assist in directing inquiries as to a USNDP point of contact if needed.

In part 2), the NP-specific topics that might be proposed for nuclear data experiments are summarized in the recent 2015 Long Range Plan for Nuclear Science [3]. These general topics are Quantum Chromodynamics, Nuclei and Nuclear Astrophysics, and Fundamental Symmetries and Neutrinos. Measurements of quantities that are needed to advance our NP research programs in these areas would be especially appropriate for this Announcement. As examples, recent “pilot” programs in nuclear data supported by NP include extended measurements of beta decays required to model antineutrino fluxes and decay heat from nuclear reactors, using the ORNL Modular Total Absorption Spectrometer (MTAS); measurements of nuclear structure and radiative transitions using Gammasphere (Argonne National Laboratory—ANL); measurements of isotope production cross sections at Los Alamos National Laboratory—LANL and Lawrence Berkeley National Laboratory —LBNL; and a nuclear theory “Topical Collaboration” study of nuclear fission and r-process nucleosynthesis, co-funded by NNSA (NA-22) and NP.

NP also envisages possibilities for participation in the Nuclear Data effort that leverage emerging technology to improve the efficiency of nuclear data curation and dissemination. Examples of areas of interest include:

- 1) Improvement in the computational infrastructure associated with the “Nuclear Data Pipeline,” notably including the computational enhancement of USNDP Evaluations;
- 2) The development of procedures for the application of High Performance Computing (HPC) to experimental nuclear data analysis, as was illustrated recently by a NERSC-NP pilot project [4]; and
- 3) The use of HPC to carry out computational studies of the properties of nuclei and nuclear systems of importance to basic research, and to nuclear applications.

Regarding the “Nuclear Data Pipeline,” the nuclear data community has noted that several tasks

need to be addressed to reduce the time required to carry out nuclear data evaluations. These include for example issues of data formats, data processing, data visualization and dissemination, quality assurance, and uncertainty quantification, which are familiar challenges in a number of SC program areas. A judiciously formulated research program in these areas which leverages progress in these areas across SC maybe able to combine nuclear community and other expertise to dramatically improve workflow and time to completion in activities associated with updating and maintaining USNDP databases.

Collaboration between nuclear scientists and computational experts from other program with relevant expertise such as the SciDAC Institutes, or FASTMath and RAPIDS may serve to accelerate progress in improving the efficiency of USNDP activities and is encouraged. .

The Frameworks, Algorithms and Scalable Technologies for Mathematics (FASTMath) Institute seeks to introduce leading-edge computational math technologies and enable the research community to develop and deploy high-performance software, using DOE supercomputers as readily-available test platforms. The Resource and Application Productivity through Computation, Information, and Data Science (RAPIDS) Institute addresses data understanding, platform readiness, and scientific data management challenges through deep engagements with applications. The FASTMath and RAPIDS Institutes provide expertise in the following topics (among many others) that may be of relevance to an application in response to this FOA:

- Management, analytics and visualization of massive and heterogeneous scientific data sets; data curation and interoperability; usability and user experience;
- Machine learning; neural-network and deep-learning models;
- Performance modeling and benchmarking, tuning and analysis, code profiling and optimization, load balancing; fault tolerance and resilience;
- Adaptive error estimation and UQ-aware methods; emulators; stochastic and numerical optimization; low-rank approximation; linear, integer, mixed-integer programming; inverse methods; Monte Carlo and quasi-Monte Carlo methods; automatic differentiation; adaptive basis sets for integration and optimization; formal V&V methods and task scheduling;
- Runtime systems, portable programming, advanced debugging capabilities and computational methods for hybrid, many and multi-core architectures, and efficient use of new and emerging memory systems;
- Workflow management, rapid prototyping, parallel I/O tools, and storage systems.

Additional information regarding these SciDAC Institutes can be found at the following links:

- FASTMath: <https://fastmath-scidac.llnl.gov/>
- RAPIDS: <https://rapids.lbl.gov>

DOE IP

Dr. Ethan Balkin (Ethan.Balkin@science.doe.gov)

The DOE IP Mission is to assure the availability of radioactive and enriched stable isotopes that are in short supply.

DOE IP supports the generation of nuclear data that is important to mission accomplishment. The needed data are cross sections/excitation functions for reactor neutron capture (n, gamma and n, fission), high energy neutron reactions (n, x) in accelerators and reactors, charged particle reactions (proton, deuteron, or alpha induced; as well as heavy ion, x), and electron accelerator-based photo-transmutation reactions (gamma, x).

Nuclear data relevant to the types of reactions described in the previous paragraph are all used in the design of targets for practical radioisotope production. These data are essential to predicting yields of desired isotopes and impurities during irradiations. Additionally, a need exists for nuclear data to support advancements in medically relevant Auger electron emitters. In order to enable more complete characterization of their therapeutic potential, measurement of the Auger electron spectra for medically relevant isotopes over a span of atomic numbers is needed.

The highest priority data are p,d,or α , x reaction cross sections; n, x reaction cross sections; and gamma, x reaction cross sections, specifically related to production of radioisotopes that are in short supply for research and applications.

A detailed list of the specific reactions of interest to isotope production activities is included in Section IX, Appendix A, and are listed according to priority, based upon requests to the National Isotope Development Center for specific isotopes, input from Federal Workshops, and isotopes captured in the 2015 Nuclear Data Needs Whitepaper.

DOE Office of Nuclear Energy (NE):

Mr. David Henderson (david.henderson@nuclear.energy.gov)

The Office of Nuclear Energy conducts research and deploys scientific results, expertise, computational tools and other advanced capabilities otherwise not commercially available for use in advancing nuclear power as a resource capable of meeting the Nation's clean energy, environmental, and national security needs. NE's leading-edge work on modelling and simulation is being made available to help accelerate early stage concepts relevant to small modular reactors, and advanced reactors across several technology areas.

NE also conducts high-priority activities to not only expand and enhance the research done through its Nuclear Science User Facilities, but also to apply new capabilities and technologies to the advancement of nuclear fuels, fuels cycles, and fuel disposition. A primary focus for NE is engagement with industry and other users through the Gateway for Accelerated Innovation in Nuclear (GAIN); please see <https://gain.inl.gov/>.

NE is interested in proposals that address nuclear data needs in these mission areas, provided that these needs are clearly demonstrated to be a limiting factor in nuclear fuel and reactor design, analysis, safety, and licensing calculations. Use of sensitivity and uncertainty analysis methods in proposed efforts is encouraged to demonstrate these needs. Some nuclear data needs for NE may be found in the NEA Nuclear Data High Priority Request List [5]. Recent studies of key safety and operational parameters highlight areas of nuclear data needs relevant to NE's mission.

Precisely determined differential cross section data and associated uncertainties are needed for certain high-priority nuclides and reactions, including but not limited to:

- ^{235}U capture in the intermediate energy range
- ^{23}Na and ^{56}Fe elastic scattering
- $^{35}\text{Cl}(n,p)$ in the intermediate and fast energy range
- Thermal neutron scattering kernels for fluorine-based molten salts
- New measurements or evaluations of $\bar{\nu}$ measurements for ^{239}Pu at thermal energies

Re-evaluation of nuclides important to nuclear energy applications, with an emphasis on data “tuning” beyond the typical k-eff responses, to ensure the accuracy of energy-dependent reactions in the predictive calculation of reactor power distributions, control rods worth, etc. are also encouraged. In particular, reviews of the ENDF/B-VIII.0 evaluations for ^{235}U , ^{239}Pu , ^1H , ^{16}O , and ^{56}Fe are needed.

Cross section covariance data useful for application analysis that account for correlations introduced in that data “tuning” process are also needed for uncertainty quantification, assessment of similarity of benchmark experiments for validation, and determination of safety margins.

Self-consistent fission product yield data is also needed, where the independent yields sum to the same values as the cumulative yields for reactor applications, especially with respect to the delayed neutron branching fractions. Associated covariance data for fission product yields is also needed.

All proposals must clearly demonstrate relevant application within NE’s research scope and include a strategy to deploy the updated data evaluated data to the end user community, such as inclusion on ENDF or ENDSF.

NNSA / Defense Nuclear Nonproliferation Research and Development (NA-22):

Dr. Donald Hornback (donald.hornback@mnsa.doe.gov)

The National Nuclear Security Administration (NNSA) seeks to advance capabilities in modeling and simulation of national security applications. This will be achieved by improving the accuracy of nuclear data that are used by the physics and engineering codes developed for specific applications relevant to the NNSA mission. In many cases there are hundreds of different components of nuclear data that are used in any given calculation, but only some subset of those typically dominate the uncertainty on the final answer. Furthermore, in many cases it is unclear if reducing the uncertainty on a given nuclear data quantity will require improved reaction theory, new experiments, or perhaps a re-evaluation of existing experimental information.

Defense Nuclear Nonproliferation R&D (DNN R&D) are requesting 9-month scoping studies that will inform future calls for proposals in specific technical areas. The scoping studies should include sensitivity studies that identify isotopes and reactions with high impact on important quantities for specific applications and assess their uncertainties. The scoping studies are also expected to determine the feasibility of significantly advancing the understanding of applications

by improving nuclear data and make a set of recommendations for a 3-5 year project.

Scoping studies are sought in three different areas:

- **Non-destructive assay for Safeguards.** UF_6 is the most abundant material in the fuel cycle, and the inventory of this material can be verified using non-destructive assay (NDA) by measuring neutrons produced primarily in the (α,n) reaction on fluorine. A 10% uncertainty on the cross section of this reaction can represent several significant quantities (SQ) of uncertainty in the unaccounted material for certain facility processes. NNSA is seeking proposals for scoping studies of alpha-induced reaction on fluorine for Safeguards, as well as other light isotopes relevant to nuclear science and technology.
- **Active interrogations with neutrons.** Active interrogation can be used in a number of non-proliferation and national security mission areas, particular in cases when passive measurements are unpractical due to low signal-to-noise ratio. Modeling and simulation of active interrogation systems require accurate nuclear data for the interrogated material. NNSA is requesting scoping studies for nuclear data relevant to active interrogation with neutrons. The most significant gaps in nuclear data are expected to be related to the gamma response from various materials during active interrogation, so proposals that addresses this area are highly encouraged.
- **Other nuclear data for national security.** In addition to the previous two topics the NNSA is also considering proposals for scoping studies on nuclear data in other areas of national security. If a strong case to be made for nuclear data needs within NNSA's mission space, proposals in that area will be considered as part of this FOA.

Budget and Budget Justification Special Instructions

Here we provide some special instructions regarding budget formulation that are specific to this Announcement.

A proposal submitted in response to this Announcement should normally include a request for support for a specified USNDP staff member, the "USNDP POC," who will be associated with the experiment, and will be responsible for transferring data generated in the experiment to the appropriate USNDP databases in a timely manner. These activities should be described both in the proposal narrative and in the Data Management Plan (DMP); see Section IV.C.2, Appendix 6. It may be useful to contact Timothy Hallman, DOE-NP Associated Director and Program Manager for Nuclear Data (timothy.hallman@science.doe.gov) and Alejandro Sonzogni, NNDC Chair (sonzogni@bnl.gov) to make appropriate arrangements with USNDP. In certain circumstances, such as a proposal that already includes suitable USNDP staff as participants in the experiment, it may be possible to waive the requirement of having a specified USNDP POC.

The budget should not propose a partition of the requested funding between Offices; in the event of a successful application, if necessary this partition will be arranged by the Program Managers in consultation with the PI. Each supporting Office would then independently provide funding through their preferred funding mechanism, subject to the availability of funding.

Each institution should also submit a detailed Budget Justification for their individual budgets. For applications that envision receiving funding from more than one Office, this budget justification may include a discussion of the separate Scope of Work that might be supported by each Office, for example through a partition of the Scope of Work into Tasks.

We recommend that PIs discuss their budget plans with the relevant Program Managers before submission of an application. (See the **Technical/Scientific Program Contacts** at the top of Section I.)

Open Science

SC is dedicated to promoting the values of openness in Federally-supported scientific research, including, but not limited to, ensuring that research may be reproduced and that the results of Federally-supported research are made available to other researchers. These objectives may be met through any number of mechanisms including, but not limited to, data access plans, data sharing agreements, the use of archives and repositories, and the use of various licensing schemes.

The use of the phrase “open-source” does not refer to any particular licensing arrangement, but is to be understood as encompassing any arrangement that furthers the objective of openness.

Collaboration

Collaborative proposals submitted from different institutions must clearly indicate they are part of a collaborative project/group. Every partner institution must submit a proposal through its own sponsored research office. Each collaborative group can have only one lead institution. Each proposal within the collaborative group, including the narrative and all required appendices and attachments, must be identical with the following exceptions:

- Each proposal must contain a correct cover page for the submitting institution only.
- Each proposal must contain a unique budget corresponding to the expenditures for that proposal’s submitting institution only.
- Each proposal must contain a unique budget justification corresponding to the expenditures for that proposal’s submitting institution only.

Our intent is to create from the various proposals associated with a collaborative group one document for merit review that consists of the common, identical proposal materials combined with a set of detailed budgets from the partner institutions. Thus, it is very important that every proposal in the collaborative group be identical (including the title) with the exception of the budget and budget justification pages.

Collaborative proposals from institutions other than DOE National Laboratories should be submitted following the above rules in response to the companion FOA, DE-FOA-0002114. Each proposal within the collaborative group submitted in response to a Laboratory Announcement and its companion FOA, including the narrative and all required appendices and attachments, must be identical with the following exceptions:

- Each proposal must contain a correct SF-424 (R&R) cover page for the submitting institution only.
- Each proposal must contain a unique budget corresponding to the expenditures for that proposal's submitting institution only.
- Each proposal must contain a unique budget justification corresponding to the expenditures for that proposal's submitting institution only.

References:

[1] "Nuclear Data Needs and Capabilities for Applications" (LBNL, May 27-29, 2015); <https://bang.berkeley.edu/events/NDNCA/whitepaper> .

[2] "Nuclear Data Needs and Capabilities for Basic Science" (Univ. of Notre Dame, Aug. 10-11, 2016); meetings.nscl.msu.edu/2016ND_workshop/ND-WhitePaper2017.pdf .

[3] "Reaching for the Horizon; the 2015 Long Range Plan for Nuclear Science" (Kitty Hawk, Apr. 16-20, 2015).

[4] "Results from Large Scale STAR Raw Data Reconstruction on NERSC HPC," R.J. Porter, J. Lauret, M. Mustafa, and J. Balewski; <https://drupal.star.bnl.gov/STAR/starnotes/public/sn0688>

[5] "NEA Nuclear Data High Priority Request List;" <https://www.oecd-nea.org/hprl>

[6] N. Touran, "Sensitivities and Uncertainties due to Nuclear Data in a Traveling Wave Reactor" (NEA/OECD/WPEC SG 39 Meeting, May 10, 2016).

Section II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding laboratory work authorizations under this DOE National Laboratory Program Announcement.

Any awards made under this Announcement will be subject to the provisions of the contract between DOE and the awardee National Laboratory.

DOE will consider funding multi-institution collaborations under this Announcement.

B. ESTIMATED FUNDING

It is anticipated that approximately \$4,000,000 per year will be available under this DOE National Laboratory Announcement, contingent on satisfactory peer review and the availability of appropriated funds. Applicants should request project support for three years. Following the first year award, out-year support will be contingent on the availability of appropriated funds, progress of the research, and programmatic needs. Awards are expected to begin in fiscal year 2020.

DOE is under no obligation to pay for any costs associated with the preparation or submission of an proposal. DOE reserves the right to fund, in whole or in part, any, all, or none of the proposals submitted in response to this DOE National Laboratory Announcement.

C. MAXIMUM AND MINIMUM AWARD SIZE

(See B. Estimated Funding section above.)

The award size will depend on the availability of appropriated funds.

Ceiling

\$1,000,000 per year

Floor

\$150,000 per year

D. EXPECTED NUMBER OF AWARDS

(See B. Estimated Funding Section above.)

The exact number of awards will depend on the number of meritorious proposals and the availability of appropriated funds.

E. ANTICIPATED AWARD SIZE

(See B. Estimated Funding Section above.)

It is anticipated that award sizes may range from \$150,000 per year to \$1,000,000 per year, typically less than \$500,000 per year, with a median award size between \$350,000 per year and \$400,000 per year.

The award size will depend on the number of meritorious proposals and the availability of appropriated funds.

F. PERIOD OF PERFORMANCE

(See B. Estimated Funding section above.)

Research Awards are expected to be made for a period of three years.

Continuation funding (funding for the second and subsequent budget periods) is contingent on: (1) availability of funds appropriated by Congress and future year budget authority; (2) progress towards meeting the objectives of the approved proposal; (3) submission of required reports; and (4) compliance with the terms and conditions of the award.

G. TYPE OF PROPOSAL

DOE will accept new DOE National Laboratory Proposals under this DOE National Laboratory Announcement. Please only submit a PAMS lab technical proposal in response to this Announcement; do not submit a DOE Field Work Proposal (FWP) at this time. SC will request FWPs later from those selected for funding consideration under this Announcement.

Section III – ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS AND TOPICS

This is a DOE National Laboratory-only Announcement. FFRDCs from other Federal agencies are not eligible to submit in response to this Program Announcement.

B. COST SHARING

Cost sharing is not required.

C. ELIGIBLE INDIVIDUALS

Eligible individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a Principal Investigator (PI) are invited to work with their organizations to develop a proposal. Individuals from underrepresented groups as well as individuals with disabilities are always encouraged to apply.

Section IV – PROPOSAL AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST PROPOSAL PACKAGE

Proposal submission instructions are available in this Announcement on the DOE SC Portfolio Analysis and Management System (PAMS). Screenshots showing the steps in DOE National Laboratory proposal submission are available in the PAMS External User Guide, accessible by navigating to <https://pamspublic.science.energy.gov> and clicking on the “PAMS External User Guide” link.

Proposals submitted outside of PAMS will not be accepted.

B. LETTER OF INTENT AND PRE-PROPOSAL

1. Letter of Intent

LETTER OF INTENT DUE DATE

[See Section IV, Part E.](#)

RESPONSE DATE

[See Section IV, Part E.](#)

A Letter of Intent is required from single-institution applicants and institutions leading multi-institutional collaborations and must be submitted by the deadline in [Section IV, Part E](#).

The LOI is to help in planning the review and the selection of potential reviewers for the proposal. For this purpose, the LOI must include the following:

- A cover sheet containing the name and mailing address of the sponsoring institution; the planned title of the research proposal; the name, e-mail address, and telephone number of the Principal Investigator, additional Senior Investigator(s), and Senior/Key personnel expected to be involved in the planned proposal.

The LOI must be submitted electronically through the DOE SC Portfolio Analysis and Management System (PAMS) website <https://pamspublic.science.energy.gov/>. It is important that the LOI be a single file with extension .pdf, .docx, or .doc. The Principal Investigator (PI) and anyone submitting on behalf of the PI must register for an account in PAMS before it will be possible to submit a letter of intent. **All PIs and those submitting LOIs on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.**

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

Please see **A. DOE Office of Science Portfolio Analysis and Management System (PAMS)** under Registrations, above, for instructions about how to register in PAMS.

Submit Your Letter of Intent:

- Create your letter of intent outside the system and save it as a file with extension .docx, .doc, or .pdf. Make a note of the location of the file on your computer so you can browse for it later from within PAMS.
- Log into PAMS and click the Proposals tab. Click the “View / View / Respond to DOE National Laboratory Announcements” link and find the current announcement in the list. Click the “Actions/Views” link in the Options column next to this announcement to obtain a dropdown menu. Select “Submit Letter of Intent” from the dropdown.
- On the Submit Letter of Intent page, select the institution from which you are submitting this LOI from the Institution dropdown. If you are associated with only one institution in the system, there will only be one institution in the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per LOI; to do so, click the “Select PI” button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the “Actions” link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose “Select PI.”
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the “Invite PI” link at the top left of the “Select PI” screen. You can enter an optional personal message to the PI in the “Comments” box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the LOI. Save the LOI for later work by clicking the “Save” button at the bottom of the screen. It will be stored in “My Letters of Intent” for later editing.
- Enter a title for your letter of intent.
- Select the appropriate technical contact from the Program Manager dropdown.
- To upload the LOI file into PAMS, click the “Attach File” button at the far right side of the screen. Click the “Browse” (or “Choose File” depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the “Upload” button to upload the file.
- At the bottom of the screen, click the “Submit to DOE” button to save and submit the LOI to DOE.
- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the LOI.

You are encouraged to register for an account in PAMS at least a week in advance of the LOI submission deadline so that there will be no delays with your submission.

WARNING: The PAMS website at <https://pampspublic.science.energy.gov> will permit you to edit a previously submitted LOI in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Laboratory Announcement should reference **LAB 19-2114**

C. CONTENT AND PROPOSAL FORMS

PROPOSAL DUE DATE

[See Section IV, Part E.](#)

Files that are attached to the forms must be PDF files unless otherwise specified in this announcement. Attached PDF files must be plain files consisting of text, numbers, and images without editable fields, signatures, passwords, redactions, or other advanced features available in some PDF-compatible software. Do not attach PDF portfolios.

WARNING: The PAMS website at https://pamspublic.science.energy.gov will permit you to edit a previously submitted proposal in the time between your submission and the deadline. If you choose to edit, doing so will remove your previously submitted version from consideration. If you are still editing at the time of the deadline, you will not have a valid submission. Please pay attention to the deadline.

RESUBMISSION OF PROPOSALS

Proposals submitted under this Announcement may be withdrawn from consideration by using SC’s PAMS website at https://pamspublic.science.energy.gov. Proposals may be withdrawn at any time between when the Laboratory submits the application and when DOE makes the application available to merit reviewers. Such withdrawals take effect immediately and cannot be reversed.

After a proposal is withdrawn, it may be resubmitted, if this Announcement is still open for the submission of applications. Such resubmissions will only count as one submission if this Announcement restricts the number of proposals from an applicant.

SC will usually consider the last submission, according to its timestamp, to be the intended version. Please consult with your program manager to resolve any confusion about which version of a proposal should be considered.

IMPROPER CONTENTS OF PROPOSALS

Proposals submitted under this Announcement will be stored in controlled-access systems, but they may be made publicly available if an award is made, and they will be made available to merit reviewers. As such, it is critical that Laboratories follow these guidelines:

- Do not include information subject to any legal restriction on its open distribution, whether classified, export control, or unclassified controlled nuclear information.
- Do not include sensitive and protected personally identifiable information, including social

security numbers, birthdates, citizenship, marital status, or home addresses. Pay particular attention to the content of biographical sketches and curriculum vitae.

- Do not include letters of support from Federal officials.
- Do not include letters of support on Federal letterhead. Letters that are not letters of support (such as letters confirming access to sites, facilities, equipment, or data; or letters from cognizant contracting officers) may be on Federal letterhead.
- Clearly mark all proprietary or trade-secret information.

LETTERS

Letters of Support should not be included in the application.

1. Summary of Proposal Contents and Information about PAMS

Each DOE National Laboratory proposal will contain the following sections:

- Budget, entered into PAMS as structured data using the PAMS budget form
- Abstract (one page), entered into PAMS as a separate pdf
- Budget justification, entered into PAMS as a separate pdf
- Proposal, combined into a single pdf containing the following information:
 - Proposal Cover Page
 - Table of Contents
 - Project Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, and responsibilities of key project personnel)
 - Appendix 1: Biographical Sketch(es)
 - Appendix 2: Current and Pending Support
 - Appendix 3: Bibliography and References Cited
 - Appendix 4: Facilities and Other Resources
 - Appendix 5: Equipment
 - Appendix 6: Data Management Plan
 - Appendix 7: Other Attachments (optional)

SUBMISSION INSTRUCTIONS

Completed proposals must be submitted into the DOE SC Portfolio Analysis and Management System (PAMS). For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submissions and inquiries about this Program Announcement should reference **LAB 19-2114**. Full proposals submitted in response to this Program Announcement must be submitted to PAMS no later than **06/28/2019**, at 5:00 PM Eastern Time.

All PIs and those submitting on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to ensure timely submissions. To register, click “Create New PAMS Account”

on the website <https://pamspublic.science.energy.gov/> and follow the instructions for creating an account.

The following information is provided to help with proposal submission. Detailed instructions and screen shots can be found in the user guide. To find the user guide, click the “External User Guide” link on the PAMS home page. Onscreen instructions are available within PAMS.

- Log into PAMS. From the proposals tab, click the “View DOE National Laboratory Announcements” link and find the current announcement in the list. Click the “Actions/Views” link in the Options column next to this Announcement to obtain a dropdown menu. Select “Submit Proposal” from the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per proposal; to do so, click the “Select PI” button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the “Actions” link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose “Select PI.”
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the “Invite PI” link at the top left of the “Select PI” screen. You can enter an optional personal message to the PI in the “Comments” box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the proposal. Save the proposal for later work by selecting “Save” from the dropdown at the bottom of the screen and then clicking the “Go” button. It will be stored in “My Proposals” for later editing. As a minimum, you must complete all the required fields on the PAMS cover page before you can save the proposal for the first time.
- The cover page, budget, and attachments sections of the lab proposal are required by PAMS before it can be submitted to DOE.
- Complete the sections in PAMS one at a time, starting with the cover page and following the instructions for each section.
- Click the “+View More” link at the top of each section to expand the onscreen instructions. On the budget section, click the “Budget Tab Instructions” link to obtain detailed guidance on completing the budget form.
- Save each section by selecting either “Save” (to stay in the same section) or “Save... and Continue to the Next Section” (to move to the next section) from the dropdown menu at the bottom of the screen, followed by clicking the “Go” button.
- If you save the proposal and navigate away from it, you may return later to edit the proposal by clicking the “View My Existing Proposals” or “My Proposals” links within PAMS.
- You must enter a budget for each annual budget period.
- You must also enter a budget for each proposed sub-award. The sub-award section can be completed using the same steps used for the budget section.
- In the attachments section of the lab proposal, the abstract, the budget justification, and the proposal narrative are required and must be submitted as separate files.

- You must bundle everything other than the budget, abstract, and budget justification into one single PDF file to be attached under “Proposal Attachment.”
- Do not attach anything under “Other Attachments.”
- To upload a file into PAMS, click the “Attach File” button at the far right side of the screen. Click the “Browse” (or “Choose File” depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the “Upload” button to upload the file.
- Once you have saved all of the sections, the “Submit to DOE” option will appear in the dropdown menu at the bottom of the screen.
- To submit the proposal, select “Submit to DOE” from the dropdown menu and then click the “Go” button.
- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the proposal.
- The proposal will also appear under My Proposals with a Proposal Status of “Submitted to DOE.”

Please only submit a PAMS lab technical proposal in response to this Announcement; do not submit a DOE Field Work Proposal (FWP) at this time. SC will request FWPs later from those selected for funding consideration under this Announcement.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submissions and inquiries about this Program Announcement should reference **LAB 19-2114**.

2. Detailed Contents of the Proposal

BUDGET AND BUDGET EXPLANATION

The budget must be submitted into PAMS using the PAMS budget form. Research proposed under this Announcement may only have one annual budget period.

PAMS will calculate the cumulative budget totals for you.

A written justification of each budget item is to follow the budget pages. The budget justification must be placed in a separate, single pdf document and attached on the appropriate screen in PAMS. Further instructions regarding the budget and justification are given below and in the PAMS software.

PROJECT SUMMARY/ABSTRACT (NO MORE THAN ONE PAGE)

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It must be a self-contained document that identifies the name of the applicant, the Principal Investigator (PI), the project title, the objectives of the project, a

description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5” by 11” paper with 1” margins (top, bottom, left and right) with font not smaller than 11 point. The one-page project summary/abstract must be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

The abstract may be used to prepare publicly accessible reports about DOE-supported research.

DOE COVER PAGE
(PART OF PROJECT NARRATIVE)

The following proposal cover page information may be placed on a plain page. No form is required. This cover page will not count in the project narrative page limitation.

- The project title:
- Applicant/Institution:
- Street Address/City/State/Zip:
- Postal Address:
- Administrative Point of Contact name, telephone number, email:
- Lead PI name, telephone number, email:
- DOE National Laboratory Announcement Number: **LAB 19-2114**
- DOE/SC Program Office: **Nuclear Physics**
- DOE/SC Program Office Technical Contact: **Timothy Hallman**
- PAMS Letter of Intent Tracking Number:
- Research area (site) identified in Section I of this Announcement

COVER PAGE SUPPLEMENT FOR COLLABORATIONS
(PART OF PROJECT NARRATIVE)

Collaborative proposals submitted from different institutions must clearly indicate they are part of a collaborative project/group. Every partner institution must submit a proposal through its own sponsored research office. Each collaborative group can have only one lead institution. Each proposal within the collaborative group, including the narrative and all required appendices and attachments, must be identical with one exception:

- Each proposal must contain the correct “cover-page” information for the submitting institution only.
- Each proposal must contain a unique budget corresponding to the expenditures for that proposal’s submitting institution only.
- Each proposal must contain a unique budget justification corresponding to the expenditures for that proposal’s submitting institution only.

SC will use the multiple proposals associated with a collaborative group to create one consolidated document for merit review that consists of the common, identical proposal materials combined with a set of detailed budgets from the partner institutions. It is very

important that every proposal in the collaborative group be identical (including the title) with the exception of the budget and budget justification pages.

If the project is a collaboration, provide the following information on a separate page as a supplement to the cover page.

- List all collaborating institutions by name with each institution’s principal investigator on the same line.
- Indicate the lead PI who will be the point of contact and coordinator for the combined research activity.
- Provide a statement explaining the leadership structure of the collaboration.
- Include a description of each collaborating institution’s facilities, equipment, and resources that will be made available to the collaborative group.
- Include a table modeled on the following chart providing summary budget information from all collaborating institutions. Provide the total costs of the budget request in each year for each institution and totals for all rows and columns.

Collaborative Proposal Information						
	Names	Institution	Year 1 Budget	Year 2 Budget	Year 3 Budget	Total Budget
Lead PI						
Co-PI						
Co-PI						
Co-PI						

Example budget table (\$ in thousands)

* Note that collaborating proposals must be submitted separately.

PROJECT NARRATIVE (NO MORE THAN 20 PAGES LONG)

The project narrative **must not exceed 20 pages** of technical information, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5” by 11” paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Merit reviewers will only consider the number of pages specified in the first sentence of this paragraph. This page limit does not apply to the Cover Page, Budget Page(s), Budget Justification, biographical material, publications and references, and appendices, each of which may have its own page limit.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the proposal. Merit reviewers are not required to access Internet sites; however, Internet publications in a list of references will be treated identically to print publications. See Part VIII.D for instructions on how to mark proprietary proposal information. To attach a Project Narrative, click “Add Attachment.”

Background/Introduction: Explanation of the importance and relevance of the proposed work as well as a review of the relevant literature.

Proposed Research and Methods: Identify the hypotheses to be tested (if any) and details of the methods to be used including the integration of experiments with theoretical and computational research efforts.

Timetable of Activities: Timeline for all major activities including milestones and deliverables.

Project Management Plan: Multi-institutional proposals must include a project management plan that clearly indicates the roles and responsibilities of each organization and indicates how activities will be coordinated and communicated among team members.

Project Objectives: This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.

The Project Narrative comprises the research plan for the project. It should contain enough background material in the Introduction, including review of the relevant literature, to demonstrate sufficient knowledge of the state of the science. The major part of the narrative should be devoted to a description and justification of the proposed project, including details of the method to be used. It should also include a timeline for the major activities of the proposed project, and should indicate which project personnel will be responsible for which activities. There should be no ambiguity about which personnel will perform particular parts of the project, and the time at which these activities will take place.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the proposal. Using Internet sites in an attempt to avoid page limits will fail: The content of those sites will not be reviewed. See Part VIII.D for instructions on how to mark proprietary proposal information.

For Collaborative Proposals Only: Each collaborating institution must submit an identical common narrative. Collaborative proposals will necessarily be longer than single-institution proposals. The common narrative may exceed the page limit described for the research narrative by 50%; i.e., if the page limit is 12 pages, a collaboration is subject to a limit of 18 pages. The common narrative must identify which tasks and activities will be performed by which of the collaborating institutions in every budget period of the proposed project. The budget and the budget justification—which are unique to each collaborating institution—may refer to parts of the common narrative to further identify each collaborating institution’s activities in the joint project. There should be no ambiguity about each institution’s role and participation in the collaborative group.

SC will use the multiple proposals associated with a collaborative group to create one consolidated document for merit review that consists of the common, identical proposal materials combined with a set of detailed budgets from the partner institutions. It is very important that every proposal in the collaborative

group be identical (including the title) with the exception of the budget and budget justification pages.

APPENDIX 1: BIOGRAPHICAL SKETCH

Provide a biographical sketch for the PI and each senior/key person as an appendix to your technical narrative.

As part of the sketch, provide information that can be used by reviewers to evaluate the PI's potential for leadership within the scientific community. Examples of information of interest are invited and/or public lectures, awards received, scientific program committees, conference or workshop organization, professional society activities, special international or industrial partnerships, reviewing or editorship activities, or other scientific leadership experiences.

- Provide the biographical sketch information as an appendix to your project narrative.
- Do not attach a separate file.
- The biographical sketch appendix will not count in the project narrative page limitation.
- The biographical information (curriculum vitae) for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point and must include:

The biographical information (curriculum vitae) must include the following items within its page limit:

- **Education and Training:** Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.
- **Research and Professional Experience:** Beginning with the current position list, in chronological order, professional/academic positions with a brief description.
- **Publications:** Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights and software systems developed may be provided in addition to or substituted for publications.
- **Synergistic Activities:** List no more than 5 professional and scholarly activities related to the effort proposed.

In addition, the biographical sketch must include information to permit DOE to identify individuals who are conflicted with or potentially biased (favorably or unfavorably) against the investigator. Include a section entitled "**Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers**" that will not count in a page limit: Provide the following information in this section:

- **Collaborators and Co-editors:** List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. For publications or collaborations with more

than 10 authors or participants, only list those individuals in the core group with whom the Principal Investigator interacted on a regular basis while the research was being done. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state “None.”

- **Graduate and Postdoctoral Advisors and Advisees:** List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s). Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates.

Personally Identifiable Information: Do not include sensitive and protected personally identifiable information including social security numbers, birthdates, citizenship, marital status, or home addresses. Do not include information that a merit reviewer should not make use of.

This appendix will not count in the project narrative page limitation.

APPENDIX 2: CURRENT AND PENDING SUPPORT

Provide a list of all current and pending support (both Federal and non-Federal) for the PI and senior/key persons, including subawardees, for ongoing projects and pending applications. List all sponsored activities or awards requiring a measurable commitment of effort, whether paid or unpaid.

For every activity, list the following items:

- The sponsor of the activity or the source of funding
- The award or other identifying number
- The title of the award or activity
- The total cost or value of the award or activity, including direct and indirect costs. For pending proposals, provide the total amount of requested funding.
- The award period (start date – end date).
- The person-months of effort per year being dedicated to the award or activity
- Briefly describe the research being performed and explicitly identify any overlaps or synergies with the proposed research.

Provide the Current and Pending Support as an appendix to your project narrative. Concurrent submission of an application to other organizations for simultaneous consideration will not prejudice its review.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 3: BIBLIOGRAPHY & REFERENCES CITED

Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication.

For research areas where there are routinely more than ten coauthors of archival publications, you may use an abbreviated style such as the Physical Review Letters (PRL) convention for citations (listing only the first author). For example, your paper may be listed as, “A Really Important New Result,” A. Aardvark et. al. (MONGO Collaboration), PRL 999. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. Provide the Bibliography and References Cited information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 4: FACILITIES & OTHER RESOURCES

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. For proposed investigations requiring access to experimental user facilities maintained by institutions other than the applicant, please provide a document from the facility manager confirming that the researchers will have access to the facility. Please provide the Facility and Other Resource information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 5: EQUIPMENT

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. Provide the Equipment information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 6: DATA MANAGEMENT PLAN

Provide a Data Management Plan (DMP) that addresses the following requirements:

1. DMPs should describe whether and how data generated in the course of the proposed research will be shared and preserved. If the plan is not to share and/or preserve certain data, then the plan must explain the basis of the decision (for example, cost/benefit considerations, other parameters of feasibility, scientific appropriateness, or limitations discussed in #4). At a minimum, DMPs must describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved.

2. DMPs should provide a plan for making all research data displayed in publications resulting from the proposed research digitally accessible to the public at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible to the public in accordance with the principles stated in the Office of Science Statement on Digital Data Management (<http://science.energy.gov/funding-opportunities/digital-data-management/>). This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.
3. DMPs should consult and reference available information about data management resources to be used in the course of the proposed research. In particular, DMPs that explicitly or implicitly commit data management resources at a facility beyond what is conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at SC User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other SC facilities can be found in the additional guidance from the sponsoring program.
4. DMPs must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all applicable laws, regulations, and DOE orders and policies. There is no requirement to share proprietary data.
5. **PLEASE NOTE:** One novel and very important purpose of this program is to provide a direct, rapid link between the new nuclear data experiments being supported and the USNDP databases, so that the new nuclear data generated by the experiment can be made publicly available in a timely manner. Accordingly, except in special circumstances, each application to this Announcement should identify and include appropriate support for a named USNDP staff member, the “USNDP POC,” who will be associated with the proposed work, participate in the plans for new data generation or the development of new procedures, and be responsible for making the new data available in the appropriate USNDP databases or incorporating the new procedures in the USNDP effort. Information regarding the identity of the USNDP POC and their planned activities should be included in the DMP. For additional information regarding this aspect of the proposal, please contact Timothy Hallman, DOE-NP Associated Director and Program Manager for Nuclear Data (timothy.hallman@science.doe.gov) and Alejandro Sonzogni, NNDC Chair (sonzogni@bnl.gov).

DMPs will be reviewed as part of the overall SC research proposal merit review process. Applicants are encouraged to consult the SC website for further information and suggestions for how to structure a DMP: <http://science.energy.gov/funding-opportunities/digital-data-management/>

- This appendix should not exceed 5 pages including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5” by 11” paper with 1 inch margins (top, bottom, left, and right)

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 7: OTHER ATTACHMENT

If you need to elaborate on your responses to questions 1-6 on the “Other Project Information” document, please provide the Other Attachment information as an appendix to your project narrative. Information not easily accessible to a reviewer may be included in this appendix, but do not use this appendix to circumvent the page limitations of the proposal. Reviewers are not required to consider information in this appendix.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

3. Detailed Instructions for the Budget

Budgets are required for the entire project period. A budget form must be completed for each budget period of the award, and a cumulative budget form for the entire project period will be populated by PAMS. A detailed budget justification narrative must be included after the budget pages. The justification must cover labor, domestic travel, equipment, materials and supplies, and anything else that will be covered with project funds.

To edit a section on the budget, click the edit icon () for each section on the page. Remember to save all budget periods before moving on to the next section. You can save the budget periods by selecting “Save All Budget Periods” from the dropdown on the lower right corner of the PAMS budget entry screen and then clicking the “Go” button. You can also save any data entry page in PAMS using the blue diskette icon () in the floating toolbar on the bottom of the screen.

Section A. Senior/Key Person (Required)

For each Senior/Key Person, enter the appropriate information. List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

Section B. Other Personnel

List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

Section C. Equipment Description

For the purpose of this budget, equipment is designated as an item of property that has an acquisition cost of \$5,000 or more and an expected service life of more than one year. (Note that this designation applies for proposal budgeting only and differs from the DOE definition of capital equipment.) List each item of equipment separately and justify each in the budget justification section. Allowable items ordinarily will be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose office equipment, such as a personal computer, is not eligible for support unless primarily or exclusively used in the

actual conduct of scientific research.

Section D. Travel

In the budget justification, list each trip's destination, dates, estimated costs including transportation and subsistence, number of staff traveling, the purpose of the travel, and how it relates to the project. Indicate whether travel cost estimates are based upon quotes from travel agencies; upon past experience of similar number of trips to similar travel destinations; or something else (describe). To qualify for support, attendance at meetings or conferences must enhance the investigator's capability to perform the research, plan extensions of it, or disseminate its results.

Section E. Participant/Trainee Support Costs:

If applicable, submit training support costs. Educational projects that intend to support trainees (precollege, college, graduate and post graduate) must list each trainee cost that includes stipend levels and amounts, cost of tuition for each trainee, cost of any travel (provide the same information as needed under the regular travel category), and costs for any related training expenses. Participant costs are those costs associated with conferences, workshops, symposia or institutes and breakout items should indicate the number of participants, cost for each participant, purpose of the conference, dates and places of meetings and any related administrative expenses. In the budget justification, indicate whether trainee cost estimates are based upon past experience of support of similar number of trainees on similar projects; past experience of support of similar number of participants attending similar conferences/workshops/symposia; or something else (describe).

Section F. Other Direct Costs:

Enter Other Direct Costs information for each item listed.

- **Materials and Supplies:** Enter total funds requested for materials and supplies in the appropriate fields. In the budget justification, indicate general categories such as glassware, and chemicals, including an amount for each category (items not identified under "Equipment"). Categories less than \$1,000 are not required to be itemized. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; quotes/catalog prices of similar or like items; or something else (describe).
- **Publication Costs:** Enter the total publication funds requested. The proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the award. In the budget justification, include supporting information. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; vendor quotes of similar publication services; or something else (describe).
- **Consultant Services:** Enter total funds requested for all consultant services. In the budget justification, identify each consultant, the services he/she will perform, total number of days, travel costs, and total estimated costs. In the budget justification, indicate whether consultant cost estimate is based upon previous experience/quotes for similar or like services; or something else (describe).
- **ADP/Computer Services:** Enter total funds requested for ADP/Computer Services. The cost of computer services, including computer-based retrieval of scientific, technical and

education information may be requested. In the budget justification, include the established computer service rates at the proposing organization if applicable. In the budget justification, indicate whether cost estimates are based upon quotes/past experience of purchase of similar computer services; established computer service rates at the proposing institution; or something else (describe).

- **Subawards/Consortium/Contractual Costs:** Enter total costs for all subawards/consortium organizations and other contractual costs proposed for the project. In the budget justification, justify the details.
- **Equipment or Facility Rental/User Fees:** Enter total funds requested for Equipment or Facility Rental/User Fees. In the budget justification, identify each rental/user fee and justify. In the budget justification, indicate whether cost estimates are based upon past experience with similar or like items; vendor quotes of similar items; or something else (describe).
- **Alterations and Renovations:** Enter total funds requested for Alterations and Renovations.
- **In the budget justification,** itemize by category and justify the costs of alterations and renovations, including repairs, painting, removal or installation of partitions, shielding, or air conditioning. Where applicable, provide the square footage and costs.
- **Other:** Add text to describe any other Direct Costs not requested above. Enter costs associated with “Other” item(s). Use the budget justification to further itemize and justify.

Section G. Direct Costs

This represents Total Direct Costs (Sections A thru F) and will be calculated by PAMS.

Section H. Other Indirect Costs

Enter the Indirect Cost information for each field. Only four general categories of indirect costs are allowed/requested on this form, so please consolidate if needed.

Section I. Total Direct and Indirect Costs

This amount will be calculated by PAMS (Sections G + H)

D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS

If selected for award, DOE reserves the right to request additional or clarifying information.

E. SUBMISSION DATES AND TIMES

1. Letter of Intent Due Date

May 15, 2019, at 5 PM Eastern Time

You are encouraged to submit your Letter of Intent well before the deadline. LOIs may be submitted at any time between the publication of this Announcement and the stated deadline.

2. Proposal Due Date

06/28/2019 at 5 PM Eastern Time

You are encouraged to transmit your proposal well before the deadline. Proposals may be submitted at any time between the publication of this Announcement and the stated deadline.

3. Late Submissions

Proposals received after the deadline will not be reviewed or considered for award.

F. FUNDING RESTRICTIONS

Funding for all awards and future budget periods are contingent upon the availability of funds appropriated by Congress and the availability of future-year budget authority.

G. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit

Proposals must be submitted through PAMS to be considered for award.

Please only submit a PAMS lab technical proposal in response to this Announcement; do not submit a DOE Field Work Proposal (FWP) at this time. SC will request FWPs via the Searchable FWP system later from those selected for funding consideration under this Announcement.

2. Registration Process

ONE-TIME REGISTRATION PROCESS

You must complete the one-time registration process (all steps) before you can submit your first proposal through PAMS. Registration instructions appear in the front matter of this Announcement.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this DOE National Laboratory Program Announcement should reference **LAB 19-2114**.

3. Proposal Receipt Notices

Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the proposal.

4. Viewing Submitted Proposals

Upon submission, the proposal will appear under My Proposals for the PI and the Submitter with a Proposal Status of “Submitted to DOE.”

Section V - PROPOSAL REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for the award; (2) the information required by the Program Announcement has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the Program Announcement, and (5) the proposed project is not duplicative of programmatic work. Proposals that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

2. Merit Review Criteria

Proposals will be subjected to scientific merit review (peer review) and will be evaluated against the following criteria, listed in descending order of importance.

- Scientific and/or Technical Merit of the Project;
- Appropriateness of the Proposed Method or Approach;
- Competency of Applicant's Personnel and Adequacy of Proposed Resources; and
- Reasonableness and Appropriateness of the Proposed Budget.
- Importance of the Proposed Contribution to Nuclear Data for Applications and Research.

The evaluation process will also include program policy factors such as the relevance of the proposed research to the terms of the DOE National Laboratory Announcement and the agency's programmatic needs, the balance of activities within the program, and the utility of the proposed activities to the broader scientific community. Note that external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of an proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

The questions below are provided to the merit reviewers to elaborate the criteria:

SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH

- What is the scientific innovation of proposed effort?
- How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality?
- How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?
- What is the likelihood of achieving influential results?
- Is the Data Management Plan suitable for the proposed research and to what extent does it support the validation of research results?

APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH

- Does the proposed effort employ innovative concepts or methods?
- How logical and feasible are the approaches?
- Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions?
- Does the applicant recognize significant potential problems and consider alternative strategies?

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- Does the proposed work take advantage of unique facilities and capabilities?
- What is the past performance of the team?
- How well qualified is the team to carry out the proposed work?
- Are the environment and facilities adequate for performing the proposed effort?

REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET

- Are the proposed budget and staffing levels adequate to carry out the proposed work?
- Is the budget reasonable and appropriate for the scope?

IMPORTANCE OF THE PROPOSED CONTRIBUTION TO NUCLEAR DATA FOR APPLICATIONS AND RESEARCH

- What is the level of importance of the proposed contribution to nuclear data that would be provided through this proposal to the applications and/or research communities?
- If an experiment is proposed, has the PI selected the most important nuclear data in the chosen area that can be addressed experimentally using the proposed facilities? Are there additional, related nuclear data needs that the PI should also consider?
- If changes or developments in the "Nuclear Data Pipeline" are proposed, would these be expected to provide a level of improvement in USNDP operations commensurate with the costs incurred?

B. REVIEW AND SELECTION PROCESS

1. Merit Review

Proposals that pass the initial review will be subjected to a formal merit review and will be evaluated based on the criteria above.

2. Program Policy Factors

The Selection Official may consider any of the following program policy factors in making the selection, listed in no order of significance:

- Availability of funds
- Relevance of the proposed activity to SC priorities
- Ensuring an appropriate balance of activities within SC programs
- Performance under current awards
- Maximizing the use of DOE user facilities
- Commitment to sharing the results of research

3. Selection

The Selection Official will consider the findings of the merit review and may consider any of the Program Policy Factors described above.

4. Discussions and Award

The Government may enter into discussions with a selected applicant for any reason deemed necessary. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

It is expected that awards will be made announced in Fiscal Year 2020.

Section VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

1. Notice of Selection

Selected Applicants Notification: DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance.

Non-selected Notification: Organizations whose proposals have not been selected will be advised as promptly as possible. This notice will explain why the proposal was not selected.

2. Notice of Award

A work authorization/contract modification issued by the contracting officer is the authorizing award document.

B. REPORTING

Annual progress reports from the award investigator will be required and will be due 90 days before the end of each budget year.

Section VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this DOE National Laboratory Program Announcement should reference **LAB 19-2114**.

Please contact the PAMS help desk for technological issues with the PAMS system.

Questions regarding the specific program areas and technical requirements may be directed to the technical contacts listed for each program within the DOE National Laboratory Program Announcement or below.

Please contact the program staff with all questions not directly related to the PAMS system.

B. AGENCY CONTACTS

PAMS Customer Support	855-818-1846 (toll-free) 301-903-9610 sc.pams-helpdesk@science.doe.gov
Program Manager Scientific Contact	<p>DOE Office of Nuclear Physics (and general information) Dr. Timothy Hallman 301-903-3613 timothy.hallman@science.doe.gov</p> <p>DOE Isotope Program Dr. Ethan Balkin 301-903-1861 ethan.balkin@science.doe.gov</p> <p>DOE Office of Nuclear Energy Mr. David Henderson 301-903-9991 david.funk@nuclear.energy.gov</p> <p>NNSA / Defense Nuclear Nonproliferation R&D (NA-22): Dr. Donald Hornback 202-586-6522 donald.hornback@nnsa.doe.gov</p>

C. DEPARTMENT OF ENERGY, OFFICE OF INSPECTOR GENERAL HOTLINE:

The Office of Inspector General (OIG) maintains a Hotline to facilitate the reporting of allegations of fraud, waste, abuse, or mismanagement in DOE programs or operations. If you wish to report such allegations, you may call, send a letter, or email the OIG Hotline ighotline@hq.doe.gov. Allegations may be reported by DOE employees, DOE contractors, or the general public. OIG contact information is available at <http://energy.gov/ig/services>.

Section VIII - OTHER INFORMATION

A. MODIFICATIONS

Notices of any modifications to this DOE National Laboratory Announcement will be posted on the Grants and Contracts website (<http://science.energy.gov/grants/>).

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE

DOE reserves the right, without qualification, to reject any or all proposals received in response to this DOE National Laboratory Announcement and to select any proposal, in whole or in part, as a basis for negotiation and/or award.

C. COMMITMENT OF PUBLIC FUNDS

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

D. PROPRIETARY PROPOSAL INFORMATION

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in a proposal only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the proposal which are to be restricted:

“The data contained in pages _____ of this proposal have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes.”

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

“The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation.”

E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its proposal, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing a proposal. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. AVAILABILITY OF FUNDS

Funds are not presently available for this award. The Government's obligation under this award is contingent upon the availability of appropriated funds from which payment for award purposes can be made. No legal liability on the part of the Government for any payment may arise until funds are made available to the Contracting Officer for this award and until the awardee receives notice of such availability, to be confirmed in writing by the Contracting Officer.

Section IX - APPENDICES/REFERENCE MATERIAL

Appendix A: 2019 Nuclear Data Needs List for Isotope Production

The following tables summarize nuclear needs relevant to the production of radioisotopes important to applications and research.

1. Charged particles

A. NUCLEAR REACTIONS FOR PROTON FLUX MONITORING

Production cross sections are needed as a function of particle energy. Care must be taken in the 80-200 MeV range to address potential secondary neutron related concerns.

Nuclear reaction	Energy range
$\text{nat}_{\text{Nb}}(\text{p},4\text{n})^{90}\text{Mo}$	Up to 200 MeV
$\text{nat}_{\text{Cu}}(\text{p},\text{xn})^{62,64}\text{Zn}$	Up to 200 MeV
$\text{nat}_{\text{Ti}}(\text{p},\text{x})^{48}\text{V}$	Up to 200 MeV

B. EXCITATION FUNCTIONS FOR ISOTOPE PRODUCTION

Production cross sections are needed as a function of particle energy.

Isotope	Target	Incident particle	Measurement type	Energy range
^{236}Np	^{235}U	d	Excitation functions for production of $^{236\text{m}},^{236\text{g}}\text{Np}$	Up to 50 MeV
		d	Excitation functions for production of co-produced impurity: $^{234,235}\text{Np}$	Up to 50 MeV
	^{236}U	p	Excitation functions for production of $^{236\text{m}},^{236\text{g}}\text{Np}$	Up to 30 MeV
		p	Excitation functions for production of co-produced impurity: $^{234,235,237}\text{Np}$	Up to 30 MeV
	^{236}U	d	Excitation functions for production of $^{236\text{m}},^{236\text{g}}\text{Np}$	Up to 50 MeV
		d	Excitation functions for production of co-produced impurity: $^{234,235,237,238}\text{Np}$	Up to 50 MeV
	^{238}U	p	Excitation functions for production of $^{236\text{m}},^{236\text{g}}\text{Np}$	Up to 50 MeV
		p	Excitation functions for production of co-produced impurity: $^{234,235,237,238,239}\text{Np}$	Up to 50 MeV
$^{93\text{m}}\text{Nb}$	^{94}Zr	p	Excitation function for production of $^{93\text{m}}\text{Nb}$	Up to 70 MeV
		p	Excitation functions for production of co-produced impurities: $^{91\text{g}},^{92\text{g}},^{93\text{g}},^{94\text{g}}\text{Nb}$	Up to 70 MeV

^{202}Pb	^{203}Tl	p	Excitation functions for production of $^{202\text{m}},^{202\text{g}}\text{Pb}$	Up to 200 MeV
		p	Excitation functions for production of co-produced impurities: $^{198},^{199},^{200},^{201},^{203}\text{Pb}$	Up to 200 MeV
	^{205}Tl	p	Excitation functions for production of $^{202\text{m}},^{202\text{g}}\text{Pb}$	Up to 200 MeV
		p	Excitation functions for production of co-produced impurities: $^{198},^{199},^{200},^{201},^{203},^{204},^{205}\text{Pb}$	Up to 200 MeV
^{205}Pb	^{206}Pb	p	Excitation functions for production of ^{205}Bi , ^{205}Pb	Up to 200 MeV
	^{206}Pb	p	Excitation functions for production of co-produced impurities: $^{198},^{199},^{200},^{201},^{202},^{203},^{204},^{205},^{206},^{207}\text{Bi}$	Up to 200 MeV
	^{204}Pb	p	Excitation functions for production of co-produced impurities: $^{198},^{199},^{200},^{201},^{202},^{203},^{204}\text{Bi}$	Up to 200 MeV
	^{207}Pb	p	Excitation functions for production of ^{205}Bi and co-produced impurities: $^{198},^{199},^{200},^{201},^{202},^{203},^{204},^{206},^{207}\text{Bi}$	Up to 200 MeV
	^{208}Pb	p	Excitation functions for production of ^{205}Bi and co-produced impurities: $^{198},^{199},^{200},^{201},^{202},^{203},^{204},^{206},^{207},^{208}\text{Bi}$	Up to 200 MeV
^{134}Ce	nat_{La}	p	Excitation function for production of ^{134}Ce	Up to 200 MeV
		p	Excitation functions for production of co-produced impurities: $^{132},^{133},^{133},^{137},^{139}\text{Ce}$	Up to 200 MeV
^{72}Se	^{75}As	p	Excitation function for production of ^{72}Se	Up to 100 MeV
		p	Excitation functions for production of co-produced impurities: $^{70},^{71},^{73},^{75}\text{Se}$	Up to 100 MeV
^{47}Sc	^{50}Ti	p	Excitation function for production of ^{47}Sc	Up to 50 MeV
		p	Excitation functions for production of co-produced impurities: $^{43},^{44},^{46},^{48},^{49}\text{Sc}$	Up to 50 MeV
^{67}Cu	^{70}Zn	p	Excitation function for production of ^{67}Cu	Up to 50 MeV
		p	Excitation functions for production of co-produced impurities: $^{61},^{62},^{64},^{66}\text{Cu}$	Up to 50 MeV
^{119}Te	nat_{Sb}	p	Excitation functions for production of $^{119\text{m}},^{119\text{g}}\text{Te}$	Up to 100 MeV
		p	Excitation functions for production of co-produced impurities: $^{116},^{117},^{118},^{121\text{m,g}},^{123\text{m}}\text{Te}$	Up to 100 MeV
	^{121}Sb	p	Excitation functions for production of $^{119\text{m}},^{119\text{g}}\text{Te}$	Up to 100 MeV
		p	Excitation functions for production of co-	Up to 100 MeV

			produced impurities: 116,117,118,121m,121g,123m _{Ta}	
^{117m} Sn	^{nat} Sb	p	Excitation function for production of ^{117m} Sn	Up to 100 MeV
		p	Excitation functions for production of co- produced impurities: 113,119m,121m,121g _{Sn}	Up to 100 MeV
	¹²¹ Sb	p	Excitation function for production of ^{117m} Sn	Up to 100 MeV
		p	Excitation functions for production of co-produced impurities: ^{113,119m} Sn	Up to 100 MeV

Other nuclear data needs for intermediate energy production of medical isotopes captured in the 2015 Nuclear Data Needs Whitepaper are listed below. Excitation functions are needed up to 100 MeV (preferably up to 200 MeV) for production of the primary isotope and for all co-produced isotopic impurities. In each case the main production nuclear reaction is indicated but it should be noted that in some cases more than one nuclear reaction contribute to the production of a particular isotope or isotopic impurity. The needs listed below are considered important but of slightly lower priority.

Non-standard p ⁺ emitters	SPECT radionuclides and generator parents	Therapeutic radionuclides
⁵⁵ Mn(p,4n) ⁵² Fe	¹²⁴ Xe(p,pn) ¹²³ Xe	⁶⁸ Zn(p,2p) ⁶⁷ Cu
⁵⁹ Co(p,3n) ⁵⁷ Ni	¹²⁴ Xe(p,2p) ¹²³ I	¹⁰⁷ Ag(p,an) ¹⁰³ Pd
⁶⁸ Zn(p,an) ⁶⁴ Cu	⁴⁵ Sc(p,2n) ⁴⁴ Ti	²³² Th(p,x) ²²⁵ Ac
⁷¹ Ga(p,4n) ⁶⁸ Ge	⁶⁹ Ga(p,2n) ⁶⁸ Ge	
⁷⁵ As(p,3n) ⁷³ Se	^{nat} Br(p,x) ⁷² Se	
⁸⁵ Rb(p,3n) ⁸³ Sr		
⁸⁸ Sr(p,3n) ⁸⁶ Y		
¹²⁵ Te(p,2n) ¹²⁴ Te		

2. Photons

A. EXCITATION FUNCTIONS FOR ISOTOPE PRODUCTION

Production cross sections are needed as a function of photon energy.

Nuclear reaction	Photon energy range
⁴⁸ Ti(ψ,p) ⁴⁷ Sc	Up to 50 MeV
⁴⁸ Ti(ψ,pn) ⁴⁶ Sc	Up to 50 MeV
⁴⁸ Ca(ψ,n) ⁴⁷ Ca	Up to 50 MeV
⁴⁸ Ca(ψ,p) ⁴⁷ K	Up to 50 MeV
⁶⁸ Zn(ψ,p) ⁶⁷ Cu	Up to 50 MeV

$^{48}\text{Ti}(\psi,p)$ ^{47}Sc	Up to 50 MeV
$^{77}\text{Se}(\psi,p)$ ^{76}As	Up to 50 MeV
$^{78}\text{Se}(\psi,p)$ ^{77}As	Up to 50 MeV
$^{78}\text{Se}(\psi,pn)$ ^{76}As	Up to 50 MeV
$^{187}\text{Os}(\psi,p)$ ^{186}Re	Up to 50 MeV
$^{189}\text{Os}(\psi,p)$ ^{188}Re	Up to 50 MeV
$^{190}\text{Os}(\psi,p)$ ^{189}Re	Up to 50 MeV
$^{196}\text{Pt}(\psi,p)$ ^{195}Ir	Up to 50 MeV
$^{196}\text{Pt}(\psi,n)$ $^{195\text{m}}\text{Pt}$	Up to 50 MeV
$^{197}\text{Au}(\psi,pn)$ $^{195\text{m}}\text{Pt}$	Up to 50 MeV
$^{197}\text{Au}(\psi,n)$ ^{196}Au	Up to 50 MeV
$^{162}\text{Dy}(\psi,p)$ ^{161}Tb	Up to 50 MeV
$^{162}\text{Dy}(\psi,pn)$ ^{160}Tb	Up to 50 MeV
$^{226}\text{Ra}(\psi,n)$ ^{225}Ra	Up to 50 MeV
$^{226}\text{Ra}(\psi,2n)$ ^{224}Ra	Up to 50 MeV

B. ACTIVATION OF CONVERTER MATERIALS

Production cross sections are needed as a function of photon energy for all activation products, with the highest priority on the major gamma dose drivers (both long-lived and short-lived).

Converter materials	Photon energy range
Tungsten	Up to 50 MeV
Tantalum	Up to 50 MeV
Gold	Up to 50 MeV
Copper	Up to 50 MeV
Stainless steel	Up to 50 MeV
Aluminum	Up to 50 MeV
Magnesium	Up to 50 MeV
Lead	Up to 50 MeV
Rhenium	Up to 50 MeV
Platinum	Up to 50 MeV

3. Neutrons

A. NUCLEAR REACTIONS FOR FAST NEUTRON FLUX CHARACTERIZATION

Production cross sections are needed as a function of neutron energy.

Nuclear reaction	Energy range
$^{209}\text{Bi}(n,3n)$ ^{207}Bi	Up to 200 MeV

$^{209}\text{Bi}(n,4n)^{206}\text{Bi}$	Up to 200 MeV
$^{209}\text{Bi}(n,5n)^{205}\text{Bi}$	Up to 200 MeV
$^{209}\text{Bi}(n,6n)^{204}\text{Bi}$	Up to 200 MeV
$\text{nat}_{\text{Lu}}(n,xn)^{173}\text{Lu}$	Up to 200 MeV
$\text{nat}_{\text{Lu}}(n,xn)^{172}\text{Lu}$	Up to 200 MeV
$\text{nat}_{\text{Lu}}(n,xn)^{171}\text{Lu}$	Up to 200 MeV
$\text{nat}_{\text{Lu}}(n,xn)^{170}\text{Lu}$	Up to 200 MeV
$\text{nat}_{\text{Lu}}(n,xn)^{169}\text{Lu}$	Up to 200 MeV
$^{169}\text{Tm}(n,3n)^{167}\text{Tm}$	Up to 200 MeV
$^{169}\text{Tm}(n,4n)^{166}\text{Tm}$	Up to 200 MeV
$^{169}\text{Tm}(n,5n)^{165}\text{Tm}$	Up to 200 MeV

B. FAST NEUTRON INDUCED REACTIONS: ISOTOPE PRODUCTION VIA THRESHOLD REACTIONS

Production cross sections are needed as a function of neutron energy.

Nuclear reaction	Energy range
$^{232}\text{Th}(n,x)^{225}\text{Ac}$	Up to 200 MeV
$^{232}\text{Th}(n,x)^{227}\text{Ac}$	Up to 200 MeV
$^{36}\text{S}(n,x)^{32}\text{Si}$	Up to 200 MeV
$\text{nat}_{\text{K}}(n,x)^{32}\text{Si}$	Up to 200 MeV
$^{37}\text{Cl}(n,x)^{32}\text{Si}$	Up to 200 MeV
$^{35}\text{Cl}(n,x)^{32}\text{Si}$	Up to 200 MeV
$^{68}\text{Zn}(n,x)^{67}\text{Cu}$	Up to 200 MeV
$^{70}\text{Zn}(n, \alpha)^{67}\text{Ni}$	Up to 200 MeV
$^{50}\text{Ti}(n,x)^{47}\text{Sc}$	Up to 200 MeV
$^{50}\text{Ti}(n, \alpha)^{47}\text{Ca}$	Up to 200 MeV
$^{226}\text{Ra}(n,2n)^{225}\text{Ra}$	Up to 200 MeV

Other nuclear data needs for fast neutron production of medical isotopes captured in the 2015 Nuclear Data Needs Whitepaper are listed below. These measurements are also considered important but of slightly lower priority. Excitation functions are typically needed up to 200 MeV.

$^{32}\text{S}(n,p)^{32}\text{P}$	$^{67}\text{Zn}(n,p)^{67}\text{Cu}$	$^{149}\text{Sm}(n,p)^{149}\text{Pm}$	$^{161}\text{Dy}(n,p)^{161}\text{Tb}$	$^{175}\text{Lu}(n,p)^{175}\text{Yb}$
$^{47}\text{Ti}(n,p)^{47}\text{Sc}$	$^{89}\text{Y}(n,p)^{89}\text{Sr}$	$^{153}\text{Eu}(n,p)^{153}\text{Sm}$	$^{166}\text{Er}(n,p)^{166m,166g}$	$^{177}\text{Hf}(n,p)^{177m,g}$
$^{64}\text{Zn}(n,p)^{64}\text{Cu}$	$^{105}\text{Pd}(n,p)^{105}\text{Rh}$	$^{159}\text{Tb}(n,p)^{159}\text{Gd}$	Ho	Lu
			$^{169}\text{Tm}(n,p)^{169}\text{Er}$	

C. LOW ENERGY NEUTRON REACTIONS: ISOTOPE PRODUCTION VIA REACTORS

Energy-resolved cross sections as well as effective cross sections for both thermal neutrons and epi-thermal neutrons are needed for production at U.S. based reactors (e.g. HFIR and ATR).

Nuclear reaction	Nuclear reaction	Nuclear reaction
Data for production of ²²⁹Th and other isotopes ²²⁷ Ra(n,y) ²²⁸ Ra - confirmation measurement needed ²²⁸ Ra(n,y) ²²⁹ Ra ²²⁸ Ac(n,y) ²²⁹ Ac ²²⁷ Th(n,y) ²²⁸ Th - confirmation measurement needed ²²⁸ Th(n,y) ²²⁹ Th - confirmation measurement needed ²²⁹ Th(n, y) ²³⁰ Th - confirmation measurement needed ²²⁹ Th(n,fission) - confirmation measurement needed ²²⁷ Th(n,fission) - confirmation measurement needed ¹⁸⁷ W(n,y) ¹⁸⁸ W - reported value not reliable ¹³³ Ba(n,y) ¹³⁴ Ba - confirmation measurement needed ¹⁰⁷ Ag(n,y) ¹⁰⁸ Ag → ¹⁰⁸ Cd(n, y) ¹⁰⁹ Cd - confirmation measurements needed	Data for SHE target isotopes production ²⁴⁸ Cm(n,y) low energy resonances ²⁴⁹ Bk(n,y) ²⁵⁰ Cf (n,y) and ²⁵⁰ Cf (n,f) ²⁵¹ Cf(n,y) and ²⁵¹ Cf (n,f) – first resonance	Data for ²⁵²Cf production ²⁴⁵ Cm(n,y) ²⁴⁷ Cm(n,y) ²⁴⁸ Cm(n,y) ²⁴⁹ Bk(n,y) ²⁵⁰ Cf(n,g) and ²⁵⁰ Cf (n,f) ²⁵¹ Cf(n,g) and ²⁵¹ Cf (n,f) ²⁵² Cf(n,X) - resonance near 1eV in particular

In addition to the tabulations above, further information on the present status and future needs for nuclear data relevant to the production and medical applications of radionuclides may be found in this review article: Qaim, S.M., *Nuclear data needs for production and applications of radionuclides: Present status and future needs*. Nucl. Med. Biol., 2017; 44:31-49.