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Laboratory Directed Research and Development Program Assessment for FY 2016

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March 2017

Brookhaven National Laboratory

U.S. Department of Energy
USDOE Office of Science (SC)

DISCLAIMER

LDRD
2016 Annual Report

BROOKHAVEN NATIONAL LABORATORY

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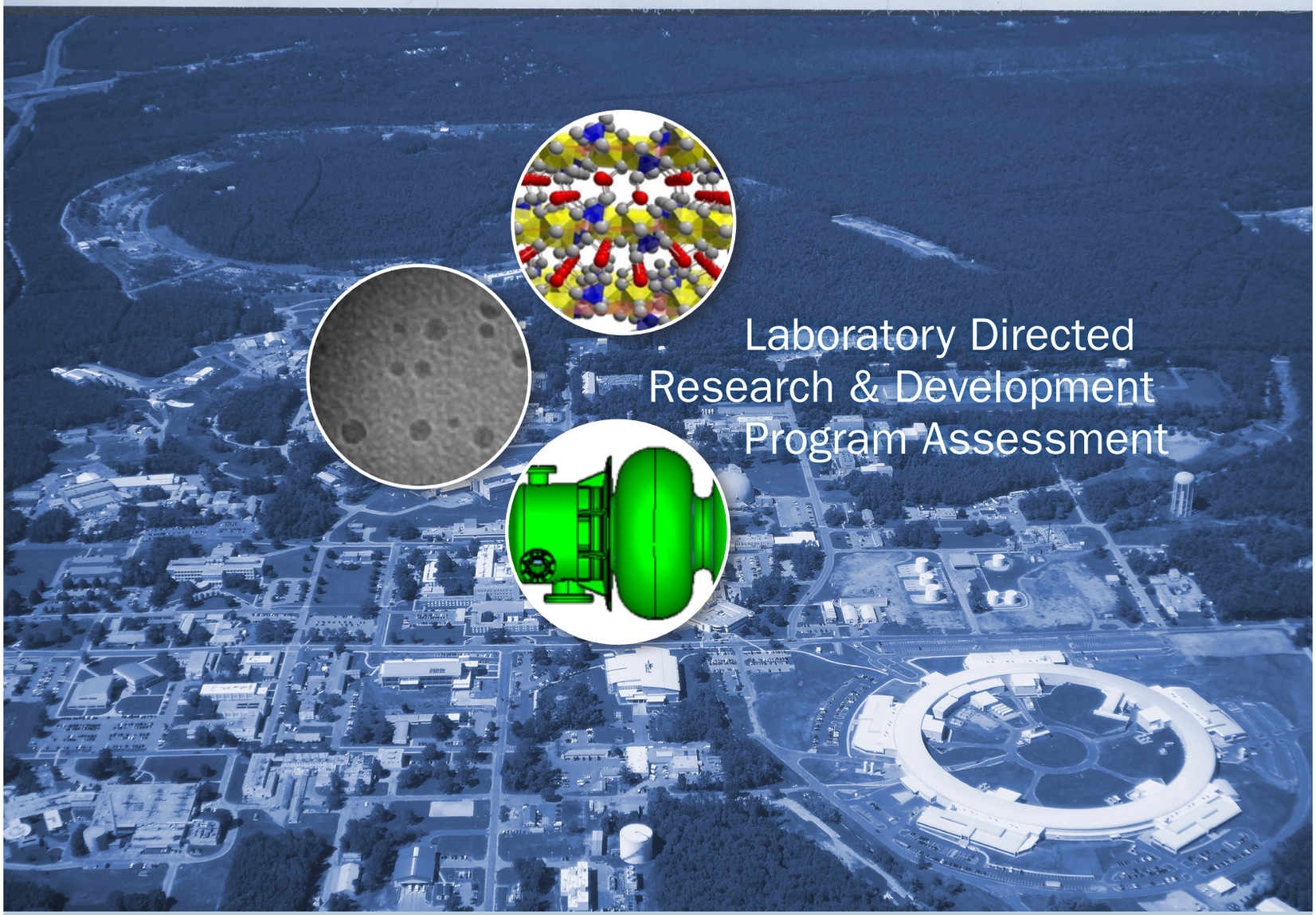


Laboratory Directed Research & Development Program Assessment

BNL-77378-2016

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES
UPTON, NEW YORK 11973-5000
UNDER CONTRACT NO. DE-SC0012704
UNITED STATES DEPARTMENT OF ENERGY

March 2017

Introduction

Each year, Brookhaven National Laboratory (BNL) is required to provide a program description and overview of its Laboratory Directed Research and Development Program (LDRD) to the Department of Energy in accordance with DOE Order 413.2C, and this report fulfills that requirement.

Brookhaven National Laboratory is managed by Brookhaven Science Associates, LLC, (BSA) under contract with the U. S. Department of Energy (DOE). BNL is a multidisciplinary Laboratory that maintains a primary mission focus in the physical, energy, and life sciences, with additional expertise in environmental sciences, energy technologies, and national security. In Fiscal Year (FY) 2016, there were 2,695 employees and 2,594 facility users, as well as guest scientists and students who come to use the Laboratory's facilities and work with the staff. Total Laboratory spending was $491M excluding costs from $85M in extraordinary construction, of which $11.5M was invested in LDRD projects.

To remain at the leading edge of science and technology (S&T), it is important to continuously foster exploratory scientific research that aims to renew the Laboratory's research agenda in areas of S&T that support BNL's mission, vision, and strategy. The LDRD program is vital in this regard. The LDRD program seeks to fund the highest quality projects through the use of calls for proposals from all qualified staff and of a highly selective review process based on peer review to ensure that only the highest quality proposals are funded. The competition for LDRD funds stimulates Laboratory scientists to think in new and creative ways and to develop cross-disciplinary collaborations, which are a major factor in achieving and sustaining research excellence and a means to address National needs within the overall mission of the DOE and BNL. By fostering high-risk, exploratory research, the LDRD program helps BNL to respond to new scientific opportunities within existing mission areas, as well as to develop new research mission areas in response to DOE and National needs. As the largest expense in BNL's LDRD program is the support of graduate students, postdoctoral research associates, and young scientists, LDRD provides the basis for continually refreshing the research staff as well as the education and training of the next generation of scientists. Hence, LDRD is essential to the scientific health and vitality of the Laboratory.

This report provides an overview of the BNL LDRD program and a summary of the management processes, project peer review, a financial overview, and the relation of the portfolio of LDRD projects to BNL's mission, initiatives, and strategic plan. Also included are a summary of success indicators and a self-assessment.

Management Process

PROGRAM ADMINISTRATION:

Overall Coordination:
Overall responsibility for coordination, oversight, and administration of BNL's LDRD Program resides with the Laboratory Director. Day-to-day responsibilities regarding funding, oversight, proposal evaluation, and report preparation for the LDRD Program reside with the Director of the Planning, Performance and Quality Management Office (PPQM).* The Office of the Associate Laboratory Director (ALD) for Business Services (ALDB) assists in the administration of the program, including administering the program budget and establishing project accounts.

Program Structure:
The overall objectives of the LDRD Program are met through the use of two broad methods for soliciting proposals. One is an open call for LDRDs and the other is through the development of Strategic LDRDs (S-LDRD).

Open call LDRDs – "Open call" LDRD projects are those that are competitively awarded based on an open call for proposals without restriction to the area of science being proposed. Proposals are typically solicited annually for review and approval concurrent with the beginning of the fiscal year, October 1. The competition is open to all BNL staff in scientific and technological areas. Researchers submit their project proposals through their respective ALD to the PPQM Director. An LDRD Project Selection Committee, comprised of the ALDs, an equal number of scientists from the Brookhaven Council, and the PPQM Director (or her delegate), review the proposals submitted in response to the solicitation against specific, documented review criteria.

Strategic LDRDs – Annually, a portion of the LDRD budget may be held for the S-LDRD category. These funds are used to establish and enhance initiatives that are consistent with Laboratory priorities and are focused on specific research areas. Projects in this category focus on innovative R&D activities that are likely to develop new core competencies within BNL's mission responsibilities and enhance the Laboratory's S&T base. The Laboratory Director entertains requests or articulates the need for S-LDRD funds at any time.

These Projects are driven by special opportunities, including

- Research project(s) in support of a Laboratory strategic hire
- Evolution of Program Development activities into R&D activities
- ALD proposal(s) to the Director to support unique research opportunities
- Research project(s) in support of Laboratory strategic initiatives as defined and articulated in the BNL Annual Laboratory Plan.

* The PPQM Office includes the Office of Policy and Strategic Planning, which administers the LDRD Program. The PPQM Director also serves as the Interim Manager of the Policy and Strategic Planning Office.

Allocating Funds:
There are several decisions to be made each year concerning the allocation of funds for the LDRD Program. These are: (1) the overall budget for the LDRD Program; (2) the amount to be allocated between the two categories, and (3) how much should go to each competing project or proposal. Senior-level management makes all of these decisions.

For each fiscal year, the Laboratory Director, on recommendation from the Deputy Director for Science and Technology (DDST), the PPQM Director, and in consultation with the ALDB, develops an overall level of funding for the LDRD Program. The budgeted amount is incorporated into the Laboratory's LDRD Plan, which formally requests authorization from the DOE to expend funds for the LDRD Program up to that authorization.

Generally, projects are authorized for funding at the start of the fiscal year. In addition, projects can be authorized throughout the fiscal year, as long as funds are available and the approved ceiling for the LDRD Program is not exceeded.

The actual level expended in the LDRD program, which may be less than authorized, is determined during the course of the year and is affected by several considerations including: the specific merits of the various project proposals, as determined by Laboratory management and the members of the LDRD Project Selection Committee; the overall financial health of the Laboratory; and a number of budgetary tradeoffs between LDRD and other overhead expenses.

Open call LDRD Selection Process:
Responsibility for the review and selection of proposals lies with a management-level group called the LDRD Project Selection Committee. In FY 2016, the Project Committee, which selected the new FY 2016 projects, consisted of ten members. The PPQM Director chaired the Committee; the other members were the three scientific ALDs, the Director of the Computational Science Initiative, the Director of the Office of Strategic Partnerships, and four Laboratory scientists from the Brookhaven Council (BC). The DDST, the Special Assistant to the Director, the Deputy Scientific ALDs and the DOE Brookhaven Site Office (BHSO) LDRD Program Manager also attended the meetings.

2016 LDRD PROJECT SELECTION COMMITTEE

Berndt Mueller	Nuclear & Particle Physics (ALD)
James Misewich	Energy and Photon Sciences (ALD)
Martin Schoonen	Environmental, Biology, Nuclear Science and Nonproliferation (ALD)
Kerstin Kleese Van Dam	Director, Computational Sciences Initiative
Lee Cheatham	Director, Office of Strategic Partnerships
Diane Hatton	Director, PPQM
Lawrence Kleinman	Environmental, Biology, Nuclear Science and Nonproliferation (BC)
Peter Petreczky	Nuclear and Particle Physics (BC)
Peter Steinberg	Nuclear and Particle Physics (BC)
Tonica Valla	Energy and Photon Sciences (BC)

Request for Proposals:
The availability of discretionary funds for research under the LDRD Program is well publicized throughout the Laboratory. Each year a call letter is sent to the Scientific Staff and as a separate memorandum to the ALDs and Department/Division Chairs. The memo for the FY 2017 call, issued in May 2016, is attached as Exhibit A.

The call references the BNL LDRD Standards-Based Management System (SBMS) Subject Area, which is accessible to all employees on the web and is attached as Exhibit D. In addition to the solicitation email, the LDRD program is publicized through feature articles on the Lab website or Monday Memo. The process that solicits and encourages the development of proposals also identifies the current LDRD strategic focus areas (if any) in which Laboratory management wishes to invest.

The LDRD SBMS Subject Area specifies the requirements necessary for participation in the program. It states the program's purpose, general characteristics, procedures for submitting proposals, and restrictions. A request for funding, i.e., a project proposal, takes the form of a completed "Proposal Information Questionnaire (PIQ)," Exhibit B. A proposal must be approved through the appropriate management levels, which include the initiator's Department/Division Business Operations Manager, the Department Chair/Division Head, and the ALD.

The ALD/Computational Science Initiative (CSI) Director runs the LDRD process for his or her Directorate. The proposed LDRD projects should support the organization's scientific goals and objectives as outlined in its Program Execution Business Plan, as well as the Laboratory's strategic objectives, although other innovative ideas are also encouraged. Each ALD/CSI Director, along with his/her management team determines the best method for screening proposals for ultimate submission to the PPQM Director. The ALD/CSI Director is responsible for developing a preliminary review process internal to that Directorate that includes peer review and addresses the selection criteria and certain minimum requirements pertaining to the DOE and BNL LDRD policies. For the FY 2017 Selection process conducted in FY 2016, each ALD was asked to submit a maximum of ten proposals to the open solicitation.

The Chair/Division Head reviews the PIQ for completeness, which includes the review of responses to questions on alignment with the Laboratory strategy, opportunities for follow-on funding, the National Environmental Policy Act and Environment, Safety, and Health. He/she also ensures that the principal investigator's (PI) regularly funded programs would not be impacted by the proposed LDRD project.

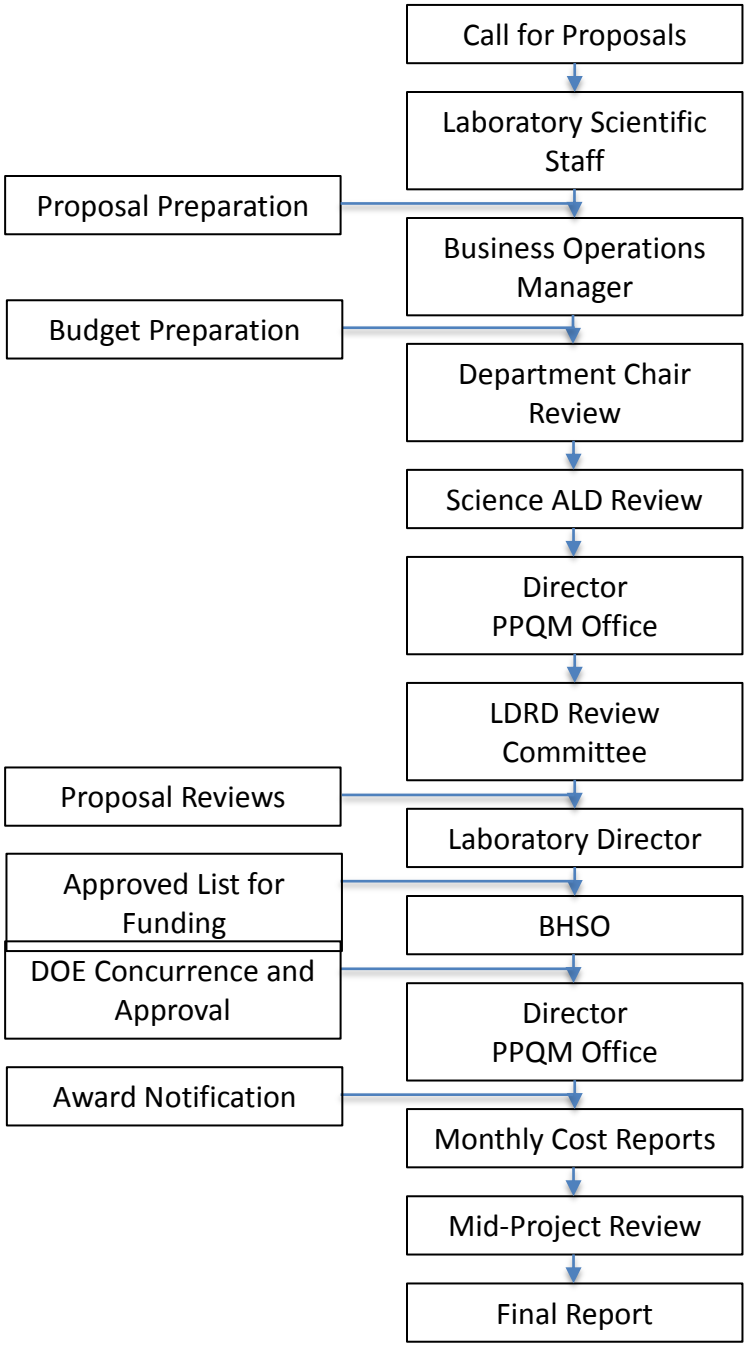
Proposal Review:
Once the ALDs/CSI Director approve the proposals, they are forwarded to the PPQM Director who transmits a copy of all proposals received to the LDRD Project Selection Committee. The Selection Committee considers all proposals submitted by the ALDs. Each member is assigned a subset of proposals to review as the designated "Reader." During the Selection Committee Meetings, the Readers provide an oral summary of the proposed research and a summary of his/her impressions of the research.

A description of the process is outlined in the Figure on the next page. All Committee members have several weeks to review the proposals and prepare for a full discussion of each proposal. The DOE BHSO Program Manager is invited to the Committee evaluation sessions as an observer.

Selection Criteria:
Minimum requirements for each proposal are: (1) consistency with program purpose; (2) consistency with the missions of BNL and DOE; (3) approval by Department Chair/Division Head and cognizant ALD; (4) assurance of satisfactory continuation of PI's regularly funded programs; (5) limited to no more than 36 months; (6) will not substitute for, supplement, or extend funding for tasks normally funded by DOE/NNSA; (7) will not create a commitment of future multi-year funding to reach a useful stage of completion; and (8) will not fund construction of line-item projects, facility maintenance, or general purpose capital equipment.

The broad selection criteria used to evaluate and rank individual proposals are stated in the LDRD SBMS Subject Area and are as follows: (1) scientific or technological merit, (2) innovation, (3) compliance with minimum requirements, (4) proposal cost as compared to the amount of available funding, and (5) potential for follow-on funding. The requirements of DOE Order 413.2C are also carefully considered during the selection process to ensure that proposals are consistent with DOE criteria.

Process for Open Call LDRD Projects



Open Call Project Selection:
Proposal abstracts are reviewed by all the Committee Members prior to the Selection Committee Meetings. At the Meetings, a brief discussion of each proposal is led by the proposal Readers who have reviewed the full proposal according to the Selection Criteria. A discussion of the proposal's merits and weaknesses is conducted and each of the proposals is ranked (coarsely). After screening each proposal, the Committee iterates further in order to reduce the number of proposals recommended for funding to a short list. Final recommendations for funding are made by concurrence of the Committee Members with input from the ALDs.

In general, some funding may be held in reserve for a potential investment in proposals submitted "off-cycle" for which a compelling case can be made. In addition, the funding amount requested in any proposal may be changed or adjusted during the approval process. The Committee's recommendation is then submitted to the Laboratory Director for approval. After approval by the Director, all new projects are submitted to the DOE BHSO for concurrence by the DOE Program Manager prior to start. The ALDB then sets up a separate Laboratory overhead account to budget and collect the costs for each project.

Strategic LDRDs Selection Process:
Responsibility for the allocation of resources and the review and the overall selection of proposals lies with the PPQM Director, the DDST, and the Laboratory Director as stated in the section of the SBMS LDRD Subject Area devoted to S-LDRD. One of the uses of S-LDRD is to support research and development of Laboratory strategic initiatives as defined and articulated in the BNL Annual Laboratory Plan.

Request for Proposals:
The availability of special funds for research under the Strategic LDRD Program is disseminated to the ALDs by the Laboratory Director.

The LDRD SBMS Subject Area (under the section on Preparing, Submitting, Reviewing, and Approving Strategic LDRD Proposals) specifies the requirements necessary for participation in the program. It states the program's purpose, general characteristics, procedures for submitting a proposal, and restrictions. Like the openly competed proposals, a request for funding, i.e., a project proposal, takes the form of a completed PIQ, Exhibit B. A proposal must be approved through the appropriate management levels, which includes the initiator's Department/Division Business Operations Manager, the Department Chair/Division Head, and the ALD.

The Chair/Division Head reviews the PIQ for completeness. This includes the review of responses to questions on alignment with the Laboratory strategy, opportunities for follow-on funding, the National Environmental Policy Act and Environment, Safety, and Health.

Proposal Review:
Once the cognizant line managers approve the proposals, they are forwarded to the PPQM Director. The PPQM Director examines the proposal for compliance with the LDRD requirements as stated in DOE Order 413.2C and the LDRD SBMS Subject Area. This includes arranging for the appropriate peer review in accordance with the Director's guidance for utilizing S-LDRD.

Project Approval:
All LDRD projects that are recommended for funding, new and continuing, are submitted to the Laboratory Director for approval. After approval by the Director, the same group of projects is submitted to the DOE BHSO for concurrence by the DOE Program Manager prior to start. The ALDB then sets up a separate Laboratory overhead account to budget and collect the costs for each project.

Project Supervision:
For all LDRD categories, the PPQM Director carries out overall oversight of projects. Supervision over the actual performance of LDRD projects is carried out in the same way as other research projects at the Laboratory. Each PI is assigned to an organizational unit (Department/Division) that is supervised by a Chair/Division Head.

Each Chair/Division Head is responsible for seeing that the obligations of the PI are satisfactorily fulfilled and that the research itself is carried out according to standard expectations of professionalism and scientific method. The PPQM Director monitors the project's status, schedule, and progress in coordination with the Chair/Division Head.

The PPQM Director (or her delegate) organizes a mid-year review of all projects and at her discretion, may conduct others. Each PI presents a progress report on the status of his/her project. In general, in attendance are the PPQM Director, the DDST, the cognizant ALD and Department Chair/Division Head, a representative from the ALDB and DOE-BHSO, the Special Assistant to the Director, and other subject matter experts, where appropriate. This review assesses the progress of the project including its funding schedule. This allows the PPQM Director to ensure that the work will be completed in a timely manner. If adequate progress has not been made, a project can be terminated at this time.

In addition, the PPQM Director conducts meetings as necessary with the DOE BHSO LDRD Program Manager to update the progress of the program and to solicit assistance to verify that the BNL LDRD Program is meeting the overall LDRD requirements. This includes providing the DOE BHSO with copies of all funded proposals, an LDRD Program database, and a project funding and schedule summary report.

Project Reporting:
Routine documentation of each project funded under the LDRD Program consists of a file containing: (1) a copy of the written proposal; (2) all interim status reports; (3) notification of changes in research direction, if any; (4) the mid-year review presentation and (5) reports on costs incurred. Also, a formal LDRD Plan, Program Assessment Report, and the Annual LDRD Report are submitted to BNL management and the DOE summarizing research progress, accomplishments, and status for all projects.

Documentation for the overall Program consists of (1) various program history files, (2) a running list of all proposals with their acceptance/rejection status, (3) funding schedule and summary reports for all approved projects, (4) permanent records on cost accounting, and a database containing information on each funded project (description, funding by fiscal year, status and accomplishments, follow-on funding, publications, etc.), (5) midyear review progress reports. A Data Collection Form (Exhibit C) is also utilized to formally collect information on the impacts of the projects. Each project is tracked for two years after its completion so as to

gather data on its impact. Also, LDRD data is input to the DOE Chief Financial Officer's Laboratory/Plant/Site Directed Research and Development Web Site (https://ldrdrpt.doe.gov) to support DOE reporting of LDRD to Congress.

The Chair of the BNL Operations Security Working Committee reviews all selected projects for classification and operational security considerations. The Office of Technology Commercialization and Partnerships also reviews them for potential intellectual property and patentable inventions or discoveries.

Peer Review

LDRD projects are peer reviewed in several different ways. Primarily, LDRD research is managed and reviewed by the cognizant Department/Division manager. These projects are a part of the research effort of the respective Department/Divisions in which the investigators reside. For the open call LDRD projects, the members of the LDRD Project Section Committee are considered to have sufficient technical knowledge to perform peer reviews of projects during the initial selection process. For the S-LDRD projects, more formal peer review is performed on each project prior to final approval. This can include external peer review.

Also, all LDRD projects undergo a mid-year review (described in the previous section under project supervision) conducted by the PPQM Director (or her delegate) that the DDST, the Chair/Division Head, cognizant ALD, the Special Assistant to the Director, a representative from the ALDB, and the DOE BHSO LDRD Program Manager attend. Other scientists and subject matter experts assist in reviews, as necessary.

In addition, external advisory committees review BNL LDRD results as part of Department, Division, and Directorate program reviews. One such group is the BSA Science and Technology Steering Committee, which performs peer reviews of Laboratory programs. Periodic scientific reviews are also conducted by various offices of DOE, where research performed under an LDRD may be presented.

Financial Overview

Operating expenses for the LDRD program are funded through the Laboratory's overhead budget, which is derived from a uniform assessment against all programmatic and Strategic Partnership Projects (formerly known as Work for Others) activities performed at the Laboratory. In March 2006, the DOE Chief Financial Officer (CFO) issued guidance that the LDRD Program will be "treated in a manner consistent with the method for distributing the general and administrative (G&A) expenses of a site." Therefore, BNL removed LDRD from the G&A pool and implemented a separate LDRD burden for investment purposes.

At BNL, the DOE authorization has ranged from $13.5M in FY 2006 to $13M in FY 2016 over the past ten years. During this same period, LDRD spending ranged from $11.5M in FY 2006 to a high of $12.2M in FY 2011 and was $11.5M in FY 2016. The costs in FY 2016 was about 2.3% of the Laboratory cost of $491M (excluding extraordinary construction). See Appendix A for a complete list of FY 2016 projects and the Project Activities Report for more details. This investment funded 48 projects, of which 21 were new starts (Exhibit E).

LDRD investment is vital to the exploration and development of research directions that will become the hallmarks of the BNL of the future in support of the Lab's mission, vision, and strategy. The BNL LDRD Program plans to fund 47 projects in FY 2017. Of these, 14 are new starts. A summary of the financial history of BNL's LDRD program is shown below.

Table 1

History of LDRD at BNL

FY	DOE AUTH. $K	BNL AUTH. $K	COSTED $K	NO. RECD.	NEW STARTS	TOTAL FUNDED
1985	4,000	1,842	1,819	39	13	13
1986	4,500	2,552	2,515	22	15	25
1987	4,000	1,451	1,443	29	8	17
1988	4,000	1,545	1,510	46	14	23
1989	4,000	2,676	2,666	42	21	29
1990	4,000	2,008	1,941	47	9	26
1991	2,000	1,353	1,321	23	14	21
1992	2,500	1,892	1,865	30	14	25
1993	2,500	2,073	2,006	35	14	28
1994	2,500	2,334	2,323	44	15	27
1995	2,500	2,486	2,478	46	13	31
1996	3,500	3,500	3,050	47	17	31
1997	4,500	4,500	3,459	71	10	28
1998	3,500	4,000	2,564	53	4	20
1999	4,750	4,612	4,526	67	25	33
2000	6,000	6,000	5,534	93	21	45
2001	6,000	6,000	5,345	97	38	70
2002	7,000	7,000	6,732	87	29	70
2003	8,500	8,482	7,830	153	44	83
2004	9,500	8,550	7,209	107	19	72
2005	10,500	9,073	8,379	114	41	78
2006	13,500*	11,460	11,460**	96	28	85
2007	15,500	13,338	11,849	99	36	74
2008	16,000	12,826	12,026	62	10	69
2009	16,500	12,137	11,673	17	6	57
2010	16,500	13,360	11,272	58	28	51
2011	16,500	12,961	12,227	40	21	50
2012	16,500	11,700	10,021	38	14	52
2013	16,500	8,925	7,596	38	15	42
2014	17,000	9,760	9,616	39	8	40
2015	13,000	10,077	9,477	40	12	43
2016	13,000	11,542	11,502	46	21	48
TOTALS	270,750	212,015	195,234	1,865	597	1,406

*A revised FY 2006 LDRD Maximum funding level of $13.5 (from $11.5M) for BNL was approved.
**Per DOE directive effective FY 2006, all LDRD projects were assessed full G&A burdens.

Relatedness of LDRD to Laboratory Programs and Scientific Outcomes

BNL's mission is to produce transformative science and advanced technologies safely, securely, and environmentally responsibly, with the cooperation and involvement of the local, national, and scientific communities. Thirteen core capabilities that can be grouped into six categories underpin scientific activities at BNL:

1. Nuclear Physics, Particle Physics, Nuclear and Radio Chemistry
2. Condensed Matter Physics and Materials Science, Chemical and Molecular Science
3. Applied Materials Science and Technology, Chemical Engineering
4. Climate Change Sciences and Atmospheric Science, Biological Systems Science
5. Accelerator Science and Technology, Large Scale User Facilities/Advanced Instrumentation, Systems Engineering and Integration
6. Advanced Computer Science, Visualization and Data.

Each of these core capabilities is comprised of a substantial combination of facilities, teams of people, and equipment that has a unique and often world-leading component and relevance to National needs that include the education of the next generation of scientists from grades K – 12 through graduate school. These core capabilities enable BNL to deliver transformational S&T that are relevant to specific DOE missions.

The Office of Science (SC) believes that these thirteen core capabilities will enable BNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and/or to pursue its vision for scientific excellence and pre-eminence. BNL has identified four Critical Outcomes that, when achieved, will realize the BSA vision for Brookhaven:

- Understanding the origins of matter and mass
- Transformational discovery through synchrotron science
- *In operando* and *in situ* energy science leadership
- Leadership in data-driven discovery.

BNL also leverages its unique resources to expand its scientific capability beyond the four scientific Critical Outcomes with leading programs in selected areas of high energy physics, biological and environmental science, nonproliferation and national security, and applied energy.

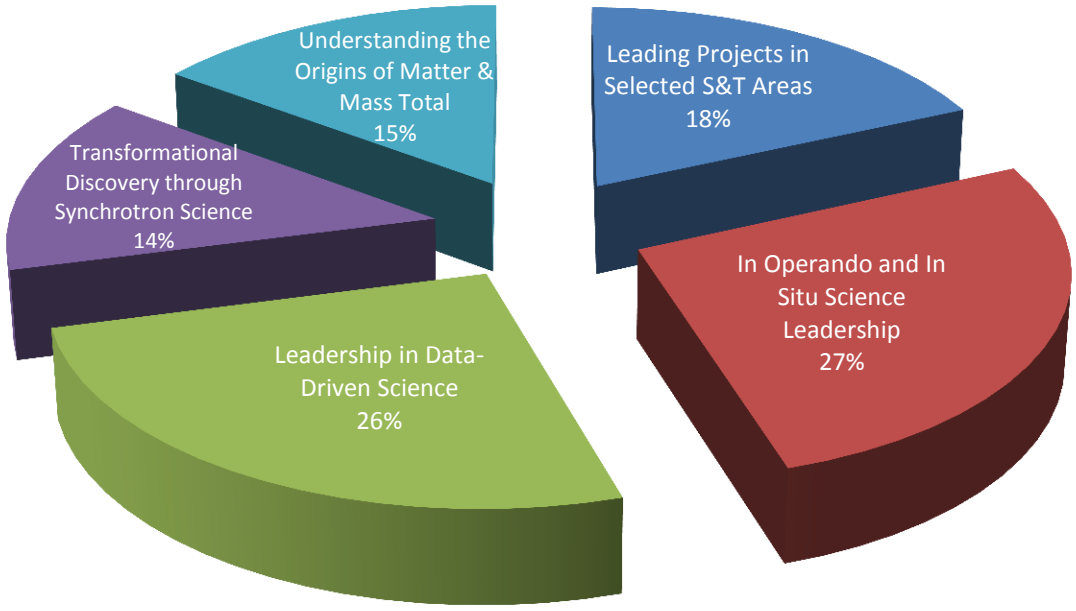
In FY 2015 and 2016, PIs were asked to identify which of these areas their proposed research supports.

The Scientific Outcomes are a primary tool by which the Laboratory builds core capabilities in particularly promising areas of S&T and conducts research to meet anticipated National needs. LDRD plays an important role in realizing successful results for the Lab's Scientific Outcomes

by providing resources in key areas of initiative development. Each year, as part of the laboratory planning cycle, Laboratory management carefully reviews existing research initiatives and emerging research opportunities, their scientific and technological promise, their match to BNL's core capabilities and mission roles, and their relevance to DOE missions and evolving national needs. During the review process, management identifies the investment needs for each Scientific Outcome. These areas are subsequently included in the annual LDRD call for proposals and given high priority for funding. Development of capabilities in these areas is essential to realizing the Lab's vision.

A chart reflecting the allocation of funds by Laboratory Scientific Outcome for projects active in FY 2016 is shown below. A list of projects by Scientific Outcome is presented as Exhibit F.

Figure 1 - Scientific Outcomes



Self-Assessment

BNL supports the concept of continual improvement as part of its management of the Laboratory. To achieve this goal, every year BNL performs self-assessments of various functions at the Laboratory. One of the programs for which the Laboratory conducts a yearly self-assessment is the LDRD program.

In FY 2016, many aspects of the program were reviewed. The following activities contributed to the Laboratory's self-assessment of the LDRD program in FY 2016:

- Review of BNL's selection process for the Open Call for FY 2017 LDRD Proposals
- Other Efforts and Changes.

Background on the FY 2016 Selection Process for FY 2017 Proposals

Among the projects in the LDRD portfolio were those in support of basic/applied research underlying breakthroughs in the effective use of renewable energy as well as projects devoted to the S&T of an Electron Ion Collider. After review of the portfolio, Senior Management decided that the optimal investment should address the Annual Laboratory Plan more broadly and during the spring of FY 2016, BNL issued an open call for FY 2017 LDRD proposals in *all* areas of S&T in support of Brookhaven's mission, vision, and strategy.

Review of BNL's Selection Process for the Open Call for FY 2017 Proposals

The Selection Process for the FY 2017 Open Call was managed similarly to the FY 2016 Open Call with direct coordination through the Science ALDs/CSI Director.

- This resulted in a set of exceptional proposals that strongly supported the Directorates' strategic directions, although innovative ideas outside of those areas were still encouraged.

The Selection Committee Members agreed that the open call process continued to result in a set of superb proposals that were reviewed in a timely manner.

- This process will be used again.

Each ALD was asked to submit a maximum of ten proposals.

- Since this reduced the number of proposals submitted from more than a hundred to thirty-four, the peer reviews from the Selection Committee were greatly improved. The length of time needed to discuss and select the proposals was also reduced. However, because the proposals, for the most part, involve cross-Directorate collaborations, we are considering using ALD Champions for the FY 2017 call.

As in previous years, each proposal was assigned to two Committee Members (Readers), who were asked to read them in their entirety, review them against the selection criteria, and provide an oral synopsis.

- This worked well for the selection of FY 2017 proposals. The Committee Members' preparation sparked a dynamic discussion that included a response from the cognizant ALD about the merits of the proposal and its ranking among the proposals submitted from that Directorate. Each was given a numerical score. Committee members were given the opportunity to contribute additional scores offline for those that they didn't rate at the

meeting.

- The potential for follow on funding will be given an even higher priority in the FY 2017 call.

Other Efforts and Changes

The PPQM Director, the LDRD Subject Matter Expert and the BHSO Program Manager attended the Office of Science Annual LDRD Program DOE Review.

- There were no specific action items for BNL.

BNL is overseeing LDRD spending more tightly. With assistance from the ALDB, tracking and trending of spending is done on a monthly basis. In coordination with the scientific ALDs, the PPQM Director is managing the recruitment of postdoctoral research associates who work on LDRD projects closely. We have instituted additional project startup budget planning to address the challenges at the beginning of projects.

- The monthly tracking and trending of spending has improved the alignment of projects with their spending plans.

After discussions between PPQM Director and the Director of the BHSO Business Management Division, the maximum funding level request to DOE for FY 2017 was held at $13M.

- Considering recent program costs, this level is more realistic.

With the transition in leadership of the LDRD Program and the incorporation of the Office of Policy and Strategic Planning into the PPQM Office in FY 2015, there was an opportunity for a fresh look at the overall Program.

- A Project Change Request process was implemented in order to better document changes to individual projects. This worked well in FY 2016.
- Annual reviews for each project were reinstated, in order to assess progress at an earlier stage. In addition, a formal LDRD "orientation" that describes the program and its importance to the Laboratory, the trade-offs that were considered by the Laboratory in setting the BNL authorization level, and the reporting requirements may be instituted in the future.

In addition to the changes to the BNL LDRD website and the Standards Based Management LDRD Subject Area that were necessitated by the new Laboratory organization structure and reported in the 2014 Assessment, other revisions to the Proposal Information Questionnaire (PIQ) were needed.

- The LDRD Subject Matter Expert and Management System Executive revised the PIQ to reflect the Laboratory's Critical Outcomes and areas where BNL will accelerate the DOE mission. A request for high level milestones for the duration of the project was also included.

The guidelines to the PIs for the annual reviews were modified to include a slide that discusses the project's return on investment (ROI).

- Although the DOE metrics capture the project's ROI, senior management wanted to learn more about the follow on activities for the research, the schedule, and how those activities would be funded, as well as whether a new program would grow from the work or how the work would enable growth in an existing program. Investment of discretionary funds, such as LDRD, and the associated ROI is a key element of the Lab's growth strategy and one that

we will continue to monitor closely.

Conclusions

In summary, BNL concludes from its self-assessment of the LDRD program that the R&D conducted is of very high quality. The focus of the call for proposals in the last few years has helped to further the objectives of the BNL Annual Laboratory Plan specifically in Energy-related R&D, R&D for an Electron-Ion Collider, first light NSLS-II experiments, and computation.

BNL will maintain its support of any new LDRD requirements and strive to continually improve by:

- Contributing to current and future DOE SC LDRD working groups to develop new work products
- Implementing any changes to the DOE CFO LDRD database
- Ensuring that all projects support the DOE missions and missions of other federal agencies
- Continuing to invite the DOE-BHSO LDRD Program Manager to all LDRD selection and project review meetings
- Conducting an annual Program self-assessment

Summary of Success Indicators

Statistical data is collected on all projects for the annual report using the Data Collection Form (Exhibit C). Since the LDRD Program is intended to promote high-risk research, the data collected has nominal value on a project-by-project basis. It does provide a general overall picture of the productivity of the LDRD Program.

Some of the more common indicators/measures of success are: 1) the number of proposed, received and approved projects, 2) amount of follow-on funding, 3) the number of patents applied for, and 4) the number of articles published in peer-reviewed journals.

Historically, statistics on the number of projects approved, compared to those rejected, show an overall approval rate of about 32 percent for new starts. For FY 2016, 21 of 46 openly competed proposals were funded. Essentially all of the scientific departments/divisions are represented in the LDRD portfolio.

An analysis of the FY 2016 projects shows that several of the PIs submitted proposals for grants or follow-on funding (several received funding), a multitude of articles or reports were published or submitted for publication, and the results were communicated broadly through scientific presentations. A summary of project success indicators for FY 2016 and those completed within the last three years (where available) is shown in the Table below. Only those accomplishments that occurred during FY 2016 are provided and not a complete summary of all the accomplishments from the projects.

SUCCESS INDICATORS FY 2016	QTY
Total number of publications originating in whole or part that were published or submitted this fiscal year	123
Total number of formal presentations originating in whole or in part including those that have been accepted for presentation but not yet presented during this fiscal year	155
Total number of reports originating in whole or in part during this fiscal year.	20
Total number of patents and licenses originating in whole or in part during this fiscal year.	1
Total number of copyrights issued/granted during this fiscal year, including those from follow on funding.	0
Total number of invention disclosures submitted during this fiscal year to the Laboratory's Office of Technology Commercialization and Partnerships that were either directly derived from the LDRD or from any follow-on efforts.	3
Total number of postdoctoral researchers and graduate students supported in full or in part during the fiscal year.	54
Total number of scientific and technical research staff hired during this fiscal year.	2
Total number of requests for follow on funding submitted this fiscal year.	31

SUCCESS INDICATORS FY 2016	QTY
Total number of national awards or recognitions received this fiscal year that are attributable in whole or in part from the project.*	5

In conclusion, the BNL LDRD Program is successful. The LDRD Program has been identified by Laboratory Management to be an important part of its future. It is a key component for developing areas of S&T for the Laboratory that align with its vision for the future and support the missions of the Department of Energy. In FY 2016 the success indicators continue to demonstrate that the Laboratory is benefitting significantly from the achievements of the LDRD Program.

* Our data collection form was clarified in FY 2013 to request only formal recognitions. This number cannot be compared directly to years prior to FY 2013.

Funding Table of LDRD Projects Approved FY 2013 - FY 2017

LDRD Project Number	Project Title	Actuals FY2013	Actuals FY2014	Actuals FY2015	Actuals FY2016	Budgeted FY2017	Total
LDRD13-006	Time Resolved Imaging of X-rays and Charged Particles		$ 283,324	$ 281,861	$ 229,737	$ 37,500	$ 832,423
LDRD13-020	Synthetic Control of Lipid Biosynthesis in Plant Vegetative Tissue	$ 240,015	278,750	213,753	74,445		806,963
LDRD13-022	Tracking Lithium Electrochemical Reaction in Individual Nanoparticles at NSLS-II	92,561	192,613	292,470	225,589		803,234
LDRD13-024	Elucidating the Role of Nanostructured Domains in CIGS PV Device Performance	147,600	401,427	279,025	4,313		832,365
LDRD13-031	Modulation Enhanced Diffraction: A New Tool for Powder Diffraction and Total Scattering Studies	67,123	213,396	138,096	3,644		422,259
LDRD13-032	Development of At-Wavelength Metrology Tools	24,143	228,155	269,995	24,943		547,236
LDRD13-033	Multidimensional Imaging Data Analysis: from Images to Science	12,600	228,194	285,831	28,229		554,855
LDRD13-034	Atomic Resolution Elemental Mapping Using X-ray Assisted STM	18,253	149,555	149,039	8,698		325,546
LDRD14-005	1st Light: Elucidating Solid-Solid Interfaces in Energy Storage Systems			193,799	509,519	460,000	1,163,318
LDRD14-021	In Situ Investigation of the Strain Distribution in Next-Generation 3D Transistors Using X-ray Nanodiffraction		107,320	177,474	97,486		382,280
LDRD14-024	Enable Early Sciences in NSLS-II with Experiment-Driven Big Data Stream System		741,946	765,477	1,274,655		2,782,078
LDRD14-028	Tissue-Specific Metabolic Models in Plants		332,241	327,923	342,572		1,002,735
LDRD14-035	Operando Studies of C1 Catalytic Reactions: Probing Model and Technical Catalysts at High Pressures Using Soft X-Rays		153,517	172,020	196,787		522,325
LDRD14-036	Correlative Microscopy, Spectroscopy and Diffraction with a Micro-Reactor		18,221	80,871	106,722	3,500	209,314
LDRD14-037	Imaging Electronic Texture in High-Temperature Superconductors			194,329	214,053		408,383
LDRD15-003	Bunch-by-Bunch Beam Position Monitor for eRHIC			71,995	123,885		195,880
LDRD15-005	Advanced Coherent Electron Cooling			304,648	287,524		592,173
LDRD15-006	Design, Fabrication and Test of SRF Cavity Prototype for eRHIC ERL			26,352	268,614	200,000	494,965
LDRD15-009	Nanoconfined Polymer Electrolytes for Rechargeable Lithium-Metal Batteries			105,167	225,006	216,546	546,719
LDRD15-010	Hydrocarbon Chemistry on Zeolite Model Systems: Towards a Detailed Understanding of Energy-Relevant Chemical Transformations Using In Situ Techniques at NSLS-II, CFN and Chemistry Department			137,149	264,032	177,058	578,239
LDRD15-011	Revealing the Structure and Dynamics of Discrete Meso-Architectures			191,725	217,019	172,985	581,728
LDRD15-020	A New Frontier for Improving Processes for Regional and Global Climate Modeling			145,068	295,000	200,000	640,069
LDRD15-025	Growth of Self-Activated Scintillators for Dual Gamma and Neutron Detection			161,177	242,267	85,000	488,444

Funding Table of LDRD Projects Approved FY 2013 - FY 2017

LDRD Project Number	Project Title	Actuals FY2013	Actuals FY2014	Actuals FY2015	Actuals FY2016	Budgeted FY2017	Total
LDRD15-031	Inelastic X-Ray Scattering Determination of the Inter- and Intra-Particle Dynamics of Nanoparticle Superlattices: Key to the Development of THz Phononic Crystals			80,739	144,566	52,570	277,875
LDRD15-034	Searching and Sorting Haystacks			53,112	211,839	133,639	398,589
LDRD15-037	In Situ Microscopy Investigation of Complex Manganese Oxides for Energy Storage			247,822	214,149	97,702	559,673
LDRD15-038	Segmented Adaptive-Gap Undulator with Different Period Lengths in Segments for Production of High Flux and Brightness Hard X-rays at NSLS-II			331,046	362,487		693,534
LDRD16-004	Chiral Magnetic Effect: From Quark-Gluon Plasma at RHIC to Dirac Semimetals at NSLS-II				196,591	170,000	366,591
LDRD16-006	Serial Micro Crystallography at Full Flux				139,389	155,980	295,369
LDRD16-007	3D Ptychography Imaging without Rotation Using Highly Convergent X-Ray Beam				111,081	197,351	308,432
LDRD16-010	100fs Single-Shot Electron Beam Slicing Technology Towards Ultra-Fast Imaging				193,522	250,000	443,522
LDRD16-019	In Situ Synchrotron Studies of Subsurface Material Interfaces Using X-Ray Fluorescence Mapping and X-Ray Tomography at NSLS-II				283,330	500,000	783,330
LDRD16-021	Characterization of Photo-Cathodes and Photoelectrons in Liquid Noble Gases				247,849	248,398	496,247
LDRD16-022	Investigation of SIPMs for Use in Nuclear and Particle Detectors				335,240	345,136	680,376
LDRD16-023	ADC and Gbit/s Link in CMOS for Large Data Generation and In Operando Analysis				311,922	308,327	620,249
LDRD16-024	Improved X-ray Spectroscopy Detectors				302,052	314,093	616,145
LDRD16-026	Microwave Kinetic Inductance Detectors: from Cosmology to NSLS2				264,062	320,406	584,468
LDRD16-027	Detector Calibration and Material Analysis - Expanding the Capabilities at NSLS II				340,227	339,087	679,314
LDRD16-029	Higher-Order-Mode (HOM) Damping for Full Luminosity of eRHIC				402,154	544,000	946,154
LDRD16-034	Advanced Silicon Detectors R&D				185,135	245,000	430,135
LDRD16-035	Resolving Technological Issues of a Compact Time Projection Chamber for Use at Both RHIC and a Future Electron Ion				240,516	240,000	480,516
LDRD16-037	Exploring Hadron Structure with Ab Initio Lattice QCD Calculations and Making Predictions for eRHIC				13,502	159,000	172,502
LDRD16-038	Preconceptual Design Study for Large Scale Structure Experiment post LSST/DESI				24,868	149,000	173,868
LDRD16-039	Machine Learning Assisted Material Discovery				294,882	494,851	789,733
LDRD16-041	Dynamic Visualization and Visual Analytics for Scientific Data at NSLS-II				402,455	240,000	642,455

Funding Table of LDRD Projects Approved FY 2013 - FY 2017

LDRD Project Number	Project Title	Actuals FY2013	Actuals FY2014	Actuals FY2015	Actuals FY2016	Budgeted FY2017	Total
LDRD16-043	Deep Structured Analysis for Image Datasets from CFN and NSLS-II				483,905	499,328	983,233
LDRD16-045	Catalysis Program in CO2 Activation				337,305	504,000	841,305
LDRD16-046	Strong-Strong Beam-Beam Interaction Studies for a Ring-Ring Based Electron Ion Collider				193,814	346,377	540,191
					$11,501,580	$8,406,834	

Office of Planning, Performance and Quality Management

BROOKHAVEN NATIONAL LABORATORY

Exhibit A
Building 460
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-5073
dhatton@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Date: May 9, 2016

To: Scientific Staff

From: D. R. Hatton, Director
Planning, Performance & Quality Management Office

Subject: Laboratory Directed Research & Development Program (LDRD) Proposals

We are now soliciting proposals for the annual LDRD competition for awards that will begin in Fiscal Year 2017. The deadline for receipt of proposals is Friday, June 17, 2016.

LDRD Proposal Topics
The primary purposes of LDRD funding are to support laboratory priority programs and programs that might lead to new directions for future support. For further details on the Lab's priority programs, see the Office of Science (SC) Laboratory Plan and the Lab Agenda at https://intranet.bnl.gov/planning/PolicyStrategicPlanningOffice.asp .

We strongly encourage the submission of interdisciplinary proposals and that you discuss proposal ideas with your Associate Laboratory Directors (ALDs).

Proposal Submission Process
ALDs, along with their management teams, should determine the best method for screening all proposals for ultimate submission. The use of peer review is strongly encouraged. Your ALD should then submit the proposals to me at dhatton@bnl.gov with a copy to Liz Flynn at lflynn@bnl.gov. Each ALD may submit no more than ten proposals.

Further information on BNL's LDRD Program is available on the LDRD website (www.bnl.gov/ldrd).

Proposal Format
For LDRD projects that are requesting less than $200k/yr, proposals cannot exceed three pages and no abstract is needed. For projects requesting more than $200k/yr, proposals cannot exceed six pages including a short, one paragraph abstract. If you are considering submitting a proposal for funding in excess of $500k/yr, please contact your ALD and me for additional information. A one-page CV is required only for the proposal's PI. As in the past, all proposals

will need to be submitted electronically on the latest version of the Proposal Information Questionnaire (PIQ) form, which can be obtained electronically at the following location: https://sbms.bnl.gov/sbmsearch/subjarea/99/3c02e011.doc

Proposal Selection Criteria
The criteria to be used for selection include:

1) The intellectual merit of the proposed activity:
- How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
- What is the specific innovative claim?
- To what extent does the proposed activity suggest and explore creative and original concepts?
- Is the proponent qualified to lead the proposed research?
- How well conceived and organized is the proposed activity?
- Is the scope of work commensurate with the requested budget?

2) The broader impacts of the proposed activity on the Laboratory:
- How does this project support the strategic directions of the Laboratory?
- Will the activity lead to new competencies at the Laboratory?
- Will this project help to ensure the scientific and technical vitality of the Laboratory?
- Does the proposal foster cross-disciplinary and/or cross-organizational unit collaborations?
- Does the proposal appropriately anticipate DOE or other sponsor needs? How can one tell?
- Does the proposal enable growth in BNL programs?

The Selection Committee will include the Deputy Director for Science and Technology, the Science ALDs, and members of the Brookhaven Council.

Finally, in conceptualizing your idea, it is important to remember that research conducted under the LDRD Program cannot duplicate or directly augment research presently funded at the Laboratory. The policy and guidelines for the BNL LDRD Program are posted at the following location: https://sbms.bnl.gov/sbmsearch/subjarea/99/99_EXH1.cfm

cc: Level I and II Managers of Science and Technology Organizations
L. Cheatham
G. Clark
J. Meadows, BHSO

BROOKHAVEN NATIONAL LABORATORY
PROPOSAL INFORMATION QUESTIONNAIRE
LABORATORY DIRECTED RESEARCH AND DEVELOPMENT PROGRAM

PRINCIPAL INVESTIGATOR		**PHONE**	
DEPARTMENT/DIVISION		**DATE**	
OTHER INVESTIGATORS			
TITLE OF PROPOSAL			
PROPOSAL TERM (month/year)	From	Through	

SUMMARY OF PROPOSAL

Description of Project:

Expected Results:

INSTRUCTIONS

Under **Description of Project**, provide a summary of the scientific concept of the proposed project including the motivation for the undertaking and the approach that will be used to conduct the investigation. *Briefly explain in a paragraph or less the competitive advantage of your approach.* Also indicate how the project meets the general characteristics of the LDRD Program and how it is tied to the DOE Mission.

Under **Expected Results**, clearly enunciate what are the expected results and how they will impact the science.

These items should not exceed the space remaining on this page, using the given font and size. The content should be understandable by the non-expert. Do not use jargon (defined by Webster as the "technical or secret vocabulary of a science"), as this has no meaning or utility to the non-expert. Submit this Summary of Proposal for review by your ALD. Upon concurrence and possible modification of your summary, follow it with an extended Proposal. In addition, include a one-page Vita of the Principal Investigator; fill out the page with citations to recent pertinent publications. Complete the Questionnaire, obtain the required approvals, and attach a budget in the form referenced. Do not include other attachments, as these will be discarded. Indicate the intent to use collaborators, postdoctoral research associates, and/or students. Go to the LDRD web site (www.bnl.gov/ldrd/) for further information. **The Instructions should be removed before proceeding.**

PROPOSAL

VITA (Principal Investigator)

1. <u>HUMAN SUBJECTS</u> (Reference: DOE Order 443.1)

Are human subjects involved from BNL or a collaborating institution? Human Subjects is defined as "A living individual from whom an investigator obtains either (1) data about that individual through intervention or interaction with the individual, or (2) identifiable, private information about that individual".

If **yes**, attach copy of the current Institutional Review Board Approval and Informed Consent Form from BNL and/or collaborating institution. Y/N _____

2. <u>VERTEBRATE ANIMALS</u>

Are live, vertebrate animals involved? Y/N _____

If **yes**, attach copy of approval from BNL's Institutional Animal Care and Use Committee. Y/N _____

3. <u>NEPA REVIEW</u>

Are the activities proposed similar to those now carried out in the Department/Division which have been previously reviewed for potential environmental impacts and compliance with federal, state, local rules and regulations, and BNL's Environment, Safety, and Health Standards? (Therefore, if funded, proposed activities would require no additional environmental evaluation.) Y/N _____

If **no**, has a NEPA review been completed in accordance with the Subject Area National Environmental Policy Act (NEPA) and Cultural Resources Evaluation and the results documented? Y/N _____

(Note: If a NEPA review has not been completed, submit a copy of the work proposal to the BNL NEPA Coordinator for review. No work may commence until the review is completed and documented.)

4. <u>ES&H CONSIDERATIONS</u>

Does the proposal provide sufficient funding for appropriate decommissioning of the research space when the experiment is complete? Y/N _____

Is there an available waste disposal path for project wastes throughout the course of the experiment? Y/N _____

Is funding available to properly dispose of project wastes throughout the course of the experiment? Y/N _____

Are biohazards involved in the proposed work? If yes, attach a current copy of approval from the Institutional Biosafety Committee. Y/N _____

Can the proposed work be carried out within the existing safety envelope of the facility (Facility Use Agreement, Nuclear Facility Authorization Agreement, Accelerator Safety Envelope, etc.) in which it will be performed? Y/N _____

If **no**, attach a statement indicating what has to be done and how modifications will be funded to prepare the facility to accept the work.

5. <u>TYPE OF WORK</u> Select Basic, Applied or Development _____

6. <u>LINK TO LABORATORY CRITICAL OUTCOMES</u>

Identify below if the proposal supports one of the scientific Critical Outcomes, which are:

- Understanding the origins of matter and mass
- Transformational discovery through synchrotron science
- *In operando* and *in situ* energy science leadership
- Leadership in data-driven discover

Or if the proposal will expand BNL's scientific impact beyond the four critical outcomes in the areas of:

- High Energy Physics
- Biological and Environmental Research
- Applied Energy Technology
- National Security, Nuclear Energy, Nuclear Science and Technology, and Isotopes

7. <u>POTENTIAL FUTURE FUNDING</u>

Identify below the Agencies and the specific program/office, which may be interested in supplying future funding. Give some indication of time frame.

APPROVALS

Business Operations Manager _____
Print Name

Department Chair/Division Manager _____
Print Name

Cognizant Associate Director _____
Print Name

BROOKHAVEN NATIONAL LABORATORY

Project Type: -
Initiative:
Department: -
Directorate:
Principal Investigator: -

-

TERM #: mm/dd/yy - mm/dd/yy

-

LABOR

TYPE	YEAR 1 FTEs	YEAR 1 COST	YEAR 2 FTEs	YEAR 2 COST	YEAR 3 FTEs	YEAR 3 COST	YEAR 4 FTEs	YEAR 4 COST	TOTAL
SCIENTIFIC/SENIOR PERSONNEL	-	-	-	-	-	-	-	-	-
POST DOCTORAL ASSOCIATES	-	-	-	-	-	-	-	-	-
OTHER PROFESSIONAL	-	-	-	-	-	-	-	-	-
OTHER	-	-	-	-	-	-	-	-	-
TOTAL LABOR	-	$ -	-	$ -	-	$ -	-	$ -	$ -

OTHER LABOR

TYPE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
CONSULTANTS/COLLABORATORS	-	-	-	-	-
JOINT APPOINTMENTS	-	-	-	-	-
DISTRIBUTED LABOR	-	-	-	-	-
STUDENT CONTRACT	-	-	-	-	-
RECHARGES	-	-	-	-	-
TOTAL OTHER LABOR	$ -	$ -	$ -	$ -	$ -

MATERIALS, SUPPLIES & TRAVEL

TYPE	CY RATE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
MATERIALS & SUPPLIES		-	-	-	-	-
TRAVEL		-	-	-	-	-
EQUIPMENT (LOW/HIGH)		-	-	-	-	-
PURCHASE HIGH VALUE		-	-	-	-	-
TOTAL MATERIALS, SUPPLIES & TRAVEL		$ -	$ -	$ -	$ -	$ -

DEPARTMENTAL OVERHEADS

TYPE	CY RATE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
ELECTRIC	0.00%	-	-	-	-	-
SPACE	0.00%	-	-	-	-	-
WASTE MGMT	0.00%	-	-	-	-	-
ORG. BURDEN	0.00%	-	-	-	-	-
OTHER	0.00%	-	-	-	-	-
TOTAL DEPARTMENTAL OVERHEADS		$ -	$ -	$ -	$ -	$ -

GENERAL & ADMINISTRATIVE OVERHEADS

TYPE	CY RATE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
TRADITIONAL G&A		-	-	-	-	-
COMMON SUPPORT		-	-	-	-	-
TOTAL G&A OVERHEADS		$ -	$ -	$ -	$ -	$ -

TOTAL PROJECT COST	YEAR 1	YEAR 2	YEAR 3	YEAR 4	**TOTAL**
TOTAL DIRECT COSTS	-	-	-	-	-
TOTAL INDIRECT COSTS	-	-	-	-	-
TOTAL PROJECT COST	$ -	$ -	$ -	$ -	$ -

NOTE:	**ITEMIZE CAPITAL INDIVIDUALLY (include item and $ amount)**	
Post Doc Rate Exception:	1.	5.
No cost to be incurred on R/C 170 (Relocation Expense)	2.	6.
Funding for Program Development for more than 2 years is unlikely and	3.	7.
cannot exceed 3 years.	4.	8.

LDRD DATA COLLECTION FORM

Read and then remove the instructions before completing this form; return it electronically to Liz Flynn (lflynn@bnl.gov)

LDRD PROJECT NUMBER:

PROJECT TITLE:

PRINCIPAL INVESTIGATOR(S):

PUBLICATIONS **TOTAL _____**

List the citations for all refereed publications originating in whole or in part from this LDRD, during the fiscal year, including those that have been submitted, but do not include any that are in preparation. Provide the total number above.

MEETINGS, PROCEEDINGS, ABSTRACTS, AND PROJECT REVIEWS
TOTAL _____

List all formal presentations originating in whole or in part from this LDRD presented during the fiscal year. Provide the total number above. Do not include the mid-year LDRD program reviews.

REPORTS **TOTAL _____**

List all formal reports originating in whole or in part from this LDRD including those that have been published during the fiscal year. Provide the total number above.

PATENTS AND LICENSES **TOTAL _____**

List all patents and licenses originating in whole or in part from this LDRD during the fiscal year. Provide the total number above.

COPYRIGHTS **TOTAL _____**

List all copyrights (other than publications) originating in whole or in part from this LDRD granted during the fiscal year. Provide the total number above.

INVENTION DISCLOSURES **TOTAL _____**

List all invention disclosures submitted during the fiscal year to the Laboratory's Office of Technology Commercialization and Partnerships that were either directly derived from this LDRD or from any follow-on efforts. Provide the total number above.

STUDENTS **TOTAL _____**

Provide the names of all students supported by this LDRD during the fiscal year and give the number of months that they were supported. Provide the total number as a head count.

POSTDOCTORAL RESEARCH ASSOCIATES **TOTAL _____**

Provide the names of all Postdoctoral Research Associates supported by this LDRD during the fiscal year and give the number of months that they were supported. Provide the total number as a head count.

NEW HIRES **TOTAL _____**

Provide names of any new staff that were hired during the fiscal year as a direct result of this LDRD. Provide the total number above. This number should not include students and postdoctoral research associates.

FOLLOW-ON FUNDING **TOTAL _____**

List all requests for funding submitted during the current and prior fiscal years including any that have been rejected. Give the title of the project, the Principal Investigator, date of submission, the name of the agency, action taken, amount funded or requested per year, and the duration. Provide the total number above.

AWARDS **TOTAL _____**

Provide information on any external awards or recognitions received during the fiscal year that are attributable in whole or in part to the LDRD project. For each award, describe (in 150 words or less) its significance and the role that LDRD played in achieving it. Provide the total number above. Examples include selection as a fellow of a scientific/technical society and receipt of an award from a scientific/technical society. This should not include follow-on funding, such as a grant from a funding agency provided above.

[Introduction] [Contents] [Forms/Exhibits] [References] [Definitions] [Keywords] [Changes]

Management System: Science and Technology Program Management

Subject Area: Laboratory Directed Research and Development (LDRD) Program

VIEW/PRINT ALL (No Exhibits and Forms)

Effective Date: **Jun 19, 2015** (Rev 3.19) Periodic Review Due: **Oct 14, 2019**	Subject Matter Expert: Patricia Giacalone	Management System Executive: Kathleen Barkigia	Management System Steward: Robert Tribble

Introduction

This subject area describes the procedures for preparing, submitting, reviewing, and approving proposals for the Laboratory Directed Research and Development (LDRD) Program. It also describes the procedures for reporting on the status of LDRD projects.

The purpose of the LDRD Program is to encourage and support the development of ideas that could lead to new programs, projects, and directions for the Laboratory. The LDRD program focuses on early exploration and exploitation of creative and innovative concepts, which enhance the ability of the Laboratory to carry out its current and future mission objectives in line with the goals of the Department of Energy (DOE). This discretionary research and development tool is viewed as one important way of maintaining the scientific excellence of the Laboratory. It is a means to stimulate the scientific-technological community (foster new science and technology ideas), which is a factor in achieving and maintaining staff excellence, and is a means to address National needs within the overall mission of the DOE.

The LDRD program includes all discretionary research and development activities other than those provided for in a DOE/NNSA program or by specific designation in the Prime Contract.

Program Structure

The program consists of two categories - open call LDRDs and Strategic LDRDs, which, when combined, meet the overall objectives of the LDRD Program.

Open Call LDRD Proposals

Proposals are solicited annually for review and approval concurrent with the start of the next fiscal year, October 1. An LDRD Selection Committee, comprised of the Associate Laboratory

Directors for the Scientific Directorates, an equal number of scientists recommended by the Brookhaven Council and the Director of Planning, Performance, and Quality Management (PPQM) review the proposals submitted in response to the solicitation.

The open call LDRD category emphasizes innovative research concepts to encourage the creativity of individual researchers. The competition is open to all BNL staff in programmatic, scientific, engineering, and technical support areas. Researchers submit their project proposals to the Director for PPQM.

Strategic LDRD Proposals

A portion of the LDRD budget is held for the Strategic LDRD (S-LDRD) category. These funds are used to establish and enhance initiatives that are consistent with Laboratory priorities. Projects in this category focus on innovative R&D activities that are likely to develop new programmatic areas within BNL's mission responsibilities and enhance the Laboratory's science and technology base. The Laboratory Director entertains requests or articulates the need for S-LDRD funds at any time.

These Projects are driven by special opportunities, including:

- Research project(s) in support of a Laboratory strategic hire
- Evolution of Program Development activities into research and development activities
- ALD proposal(s) to the Director to support unique research opportunities
- Research project(s) in support of Laboratory strategic initiatives as defined and articulated by the Director.

Contents

Section	Overview of Content (see section for full process)
1. Preparing, Submitting, Reviewing, and Approving Open Call LDRD Proposals	• Complete Proposal Information Questionnaire. • Review and approve proposals. • Authorize funding.
2. Preparing, Submitting, Reviewing, and Approving Strategic LDRD Proposals	• Complete Proposal Information Questionnaire. • Review and approve proposals.

- Authorize funding.

3. Preparing and Submitting Reports on LDRD Projects

- Submit status reports.

Definitions

Exhibits

Examples of Projects for LDRD Funding
Restrictions on LDRD Awards
Sample Interim Status Report

Forms

LDRD Data Collection Form
Proposal Information Questionnaire
Strategic LDRD Proposal Review with Instructions

Training Requirements and Reporting Obligations

This subject area does not contain training requirements.

This subject area contains the following reporting obligations:

- Principal Investigators (PIs) submit an annual status report by November 1 to the Director of PPQM.
- PIs present an Annual LDRD Mid-year Project Review.
- For each year that the program is active and for two years after the completion of the project, PIs submit a LDRD Data Collection Form to the Director of PPQM.
- Director of PPQM submits an Annual Program Plan to the DOE BHSO by August 15
- Director of PPQM submits an Annual Report to the DOE BHSO by March 31
- Director of PPQM annually submits Project Data Sheets to the DOE BHSO by August 31
- Director of PPQM annually submits the required information to OMBE/CFO Database
- Director of PPQM annually submits to DOE Laboratory Policy Division data for Congressional report
- Director of PPQM annually submits performance indicators data to DOE Laboratory Policy Division

See the section Preparing, Submitting, Reviewing, and Approving Strategic LDRD Proposals.

External/Internal Requirements

Requirement Number	Requirement Title
BSA Contract No. DE-SC0012704 - Clause C.4	Statement Of Work
O 413.2C (Oct 22, 2015)	Laboratory Directed Research and Development

References

Laboratory Directed Research and Development (LDRD) Web site

Standards of Performance

Provide for strategic growth and investment in the Laboratory's programmatic mission and supporting assets through the following:

- Using Laboratory Directed Research and Development (LDRD);
- Maintaining an Annual Laboratory Plan through a process for formal strategic planning; and
- Maintaining a supportive work environment that fosters innovative scientific and technological research and analysis to serve customers' needs, and staff development to address long-term organizational needs and staff career goals.

All staff shall ensure that the scientific and technical information resulting from BNL research is available to the maximum permissible extent for future use by the scientific community and the public within BNL's and the customer's requirements.

Laboratory Directed Research and Development (LDRD)

Program Description

The purpose of the Laboratory Directed Research and Development (LDRD) Program is to promote the conduct of highly innovative and exploratory research that supports the mission of the Laboratory including strategic initiatives for the growth of the Laboratory. The Laboratory mission areas include the physical, energy, and life sciences, with additional expertise in environmental sciences, energy technologies, and national security, as well as the design, construction, and operation of large-scale scientific facilities. The following is a list of the general principles that guide the LDRD Program:

- Fund highly innovative and exploratory research that can be of high risk.
- Expect high payoff such as funding prospects, breakthrough science and broadening of the Laboratory's mission.
- Set a fraction of the funds for strategic areas.
- Give some preference to emerging scientists consistent with the quality of their proposals.
- Encourage collaborations across Directorates and Departments/Divisions.
- Do not use the LDRD process as a way to support unfunded investigators.
- Stop support if funding is obtained elsewhere.
- Track the productivity and success of funded proposals.

Program Structure

The program has two categories, the annual open call LDRDs and Strategic LDRDs, which combine to meet the overall objective of the LDRD Program.

Open call LDRD Proposals

Proposals are solicited annually for review and approval concurrent with the next fiscal year, October 1. An LDRD Selection Committee, comprised of the Associate Laboratory Directors (ALDs), an equal number of scientists from the Brookhaven Council, and the Director of Planning, Performance and Quality Management (PPQM) reviews the proposals submitted in response to the solicitation. The ALDs as a group with the benefit of peer reviews from the entire Committee make the final selections for the Laboratory-wide competition. Successful organization and execution of each approved proposal is the responsibility of the cognizant ALD in the area of activity.

The open call LDRD category emphasizes innovative research concepts. The competition is open to all BNL research staff. Researchers submit their project proposals to their respective ALDs, who along with their management teams, determine the best method for screening proposals for ultimate submissionto the Director of PPQM.

Strategic LDRD Proposals

A portion of the LDRD budget is held for the Strategic LDRD (S-LDRD) category. These funds are used to establish and enhance initiatives that are consistent with Laboratory priorities. Projects in this category focus on innovative R&D activities that are likely to develop new programmatic areas within BNL's mission focus and enhance the Laboratory's science and technology base. The

Laboratory Director entertains requests or articulates the need for S-LDRD funds at any time. The Director of PPQM arranges for the appropriate review in accordance with the Director's guidance.

These projects are driven by special opportunities, including:

- Research project(s) in support of a Laboratory strategic hire,
- Evolution of Program Development activities into research and development activities,
- ALD proposal(s) to the Director to support unique research opportunities,
- Research project(s) in support of Laboratory strategic initiatives as defined and articulated by the Director.

Administration

Further information and assistance can be obtained from Kathi Barkigia either by email (**barkigia@bnl.gov**) or telephone (ext. 7661), or Pat Giacalone, Budget Office, email (**pgiacalo@bnl.gov**) or telephone (ext. 4628).

Documentation on all approved LDRD projects is maintained by the Office of Policy and Planning to assure that projects have undergone proper review and are in compliance with all applicable requirements.

Exhibits

- **Data Collection Form**
- **PIQ Form**
- **Sample Interim Status Report**

LDRD Program Data

- **FY17 List of Funded Projects**
- **FY16 List of Funded Projects**
- **FY15 List of Funded Projects**
- **FY14 List of Funded Projects**
- **FY13 List of Funded Projects**
- **FY12 List of Funded Projects**
- **FY11 List of Funded Projects**
- **FY10 List of Funded Projects**
- **FY09 List of Funded Projects**
- **FY08 List of Funded Projects**
- **FY07 List of Funded Projects**
- **FY06 List of Funded Projects**
- **FY05 List of Funded Projects**
- **FY04 List of Funded Projects**
- **FY03 List of Funded Projects**
- **FY02 List of Funded Projects**

Relationship of FY 2016 LDRD Projects to Laboratory Scientific Outcomes

Project Number	Title
	Leading Programs in Selected Areas
13-006	Time Resolved Imaging of X-rays and Charged Particles
13-020	Synthetic Control of Lipid Biosynthesis in Plant Vegetative Tissue
14-028	Tissue-Specific Metabolic Models in Plants
15-025	Growth of Self-Activated Scintillators for Dual Gamma and Neutron Detection
16-021	Characterization of Photo-Cathodes and Photoelectrons in Liquid Noble Gases
16-022	Investigation of SIPMs for Use in Nuclear and Particle Detectors
16-023	ADC and Gbit/s Link in CMOS for Large Data Generation and In Operando Analysis
16-024	Improved X-ray Spectroscopy Detectors
16-038	Preconceptual Design Study for Large Scale Structure Experiment post LSST/DESI
	Data Driven Science
13-033	Multidimensional Imaging Data Analysis: From Images to Science
14-024	Enable Early Sciences in NSLS-II with Experiment-Driven Big Data Stream System
15-020	A New Frontier for Improving Processes for Regional and Global Climate Modeling
15-034	Searching and Sorting Haystacks
16-039	Machine Learning Assisted Material Discovery
16-041	Dynamic Visualization and Visual Analytics for Scientific Data at NSLS-II
16-043	Deep Structured Analysis for Image Datasets from CFN and NSLS-II

Although a project may support more than one Scientific Outcome, each one is assigned to only one category.

In operando / In situ Energy Sciences

13-022	Tracking Lithium Electrochemical Reaction in Individual Nanoparticles at NSLS-II
13-024	Elucidating the Role of Nanostructured Domains in CIGS PV Device Performance
14-005	1st Light: Elucidating Solid-Solid Interfaces in Energy Storage Systems
14-021	In Situ Investigation of the Strain Distribution in Next-Generation 3D transistors using X-ray Nanodiffraction
14-035	Operando Studies of C1 Catalytic Reactions: Probing Model and Technical Catalysts at High Pressures using Soft S-rays
14-036	Correlative Microscopy, Spectroscopy and Diffraction with a Micro-Reactor
14-037	Imaging Electronic Texture in High-Temperature Superconductors
15-009	Nanoconfined Polymer Electrolytes for Rechargeable Lithium-Metal Batteries
15-010	Hydrocarbon Chemistry on Zeolite Model Systems: Towards a Detailed Understanding of Energy-Relevant Chemical Transformations Using In Situ Techniques at NSLS-II, CFN and Chemistry Department
15-011	Revealing the Structure and Dynamics of Discrete Meso-Architectures
15-037	In Situ Microscopy Investigation of Complex Manganese Oxides for Energy Storage
16-004	Chiral Magnetic Effect: From Quark-Gluon Plasma at RHIC to Dirac Semimetals at NSLS-II
16-019	In Situ Synchrotron Studies of Subsurface Material Interfaces Using X-ray Fluorescence Mapping and X-ray Tomography at NSLS-II
16-045	Catalysis Program in CO2 Activation

Origins of Matter and Mass

15-003	Bunch-by-Bunch Beam Position Monitor for eRHIC
15-005	Advanced Coherent Electron Cooling
15-006	Design, Fabrication and Test of SRF Cavity Prototype for eRHIC ERL
16-029	Higher-Order-Mode (HOM) Damping for Full Luminosity of eRHIC
16-034	Advanced Silicon Detectors R&D

Although a project may support more than one Scientific Outcome, each one is assigned to only one category.

16-035	Resolving Technological Issues of a Compact Time Projection Chamber for Use at Both RHIC and a Future Electron Ion Collider
16-037	Exploring Hadron Structure with Ab Initio Lattice QCD Calculations and Making Predictions for eRHIC
16-046	Strong-Strong Beam-Beam Interaction Studies for a Ring-Ring Based Electron Ion Collider

Synchrotron Science

13-031	Modulation Enhanced Diffraction: A New Tool for Powder Diffraction and Total Scattering Studies
13-032	Development of At-Wavelength Metrology Tools
13-034	Atomic Resolution Elemental Mapping Using X-ray Assisted STM
15-031	Inelastic X-Ray Scattering Determination of the Inter- and Intra-Particle Dynamics of Nanoparticle Superlattices: Key to the Development of THz Phononic Crystals
15-038	Segmented Adaptive-Gap Undulator with Different Period Lengths in Segments for Production of High Flux and Brightness Hard X-rays at NSLS-II
16-006	Serial Micro Crystallography at Full Flux
16-007	3D Ptychography Imaging without Rotation Using Highly Convergent X-ray Beam
16-010	100fs Single-Shot Electron Beam Slicing Technology Towards Ultra-Fast Imaging
16-026	Microwave Kinetic Inductance Detectors: from Cosmology to NSLS-II
16-027	Detector Calibration and Material Analysis - Expanding the Capabilities at NSLS-II

Although a project may support more than one Scientific Outcome, each one is assigned to only one category.

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Department of Energy
Office of Science
Washington, DC 20585

MEMORANDUM FOR FRANK J. CRESCENZO
MANAGER
BROOKHAVEN SITE OFFICE

FROM: CHERRY A. MURRAY
DIRECTOR, OFFICE OF SCIENCE

SUBJECT: Approval of FY 2017 LDRD Plan and Funding Level

Based on your recommendation, a review of the Brookhaven National Laboratory's (BNL) FY 2017 laboratory directed research and development (LDRD) plan, and the Laboratory's ability to effectively manage the LDRD program, this memorandum provides approval of the BNL FY 2017 LDRD plan and associated maximum funding level of 2.3%. Approval of the BNL's funding level is contingent upon your office's concurrence on each proposed LDRD project to ensure compliance with the requirements of the DOE LDRD Order and subsequent Departmental and Office of Science guidance documents.

We recognize how essential the LDRD program is to the health and vitality of the Laboratory, and how this program clearly enhances the lab's ability to support the missions of the Department. As always, the Laboratory needs to continue to conduct its LDRD program in full compliance with Departmental policy.

If you have any questions, please contact John LaBarge at (202) 586-9747.

cc: J. Meadows, Brookhaven Site Office