Laboratory Directed Research and Development (LDRD) Review by ASCAC* Subcommittee

Martin Berzins, Chair

(Karin Remington, ASCAC subcommittee member, presenting)

- On behalf of, and with: BERAC, BESAC, FESAC, HEPAP, NSAC, DPAC, EMB and NEA (acronyms explained shortly)

What is LDRD?

Laboratory Directed Research and Development (LDRD):

- Provides the Laboratories with the opportunity to invest in high-risk, potentially high-value research and development to:
  - Maintain the **scientific and technical vitality** of the Laboratories;
  - Enhance the Laboratories' **ability to address future** DOE/NNSA missions;
  - **Foster creativity** and stimulate exploration of **forefront science and technology**; and
  - Serve as a **proving ground for new concepts** in research and development.
- Provides an avenue to recruit **strategic new hires**, **attract and support the best quality students/post-docs** and **retain key scientists**.
- LDRD is the only discretionary research funding available to each Laboratory Director to use to **strengthen the Lab's core competencies and position each for the future**.

Note: Many LDRD projects **address multiple aims above.**

Subcommittee Charge:

- In June 2015, the Secretary of Energy Advisory Board's (SEAB) Task Force on DOE National Laboratories recommended an independent peer review of the LDRD program impacts and process of four laboratories, evaluating up to ten years of funded projects. Following that guidance, in May 2016, Secretary Murray sent a charge letter to ASCAC Chair Daniel Reed, asking ASCAC to convene a subcommittee to respond to this recommendation.

ASCAC was asked to "**review the LDRD program processes and the impact of LDRD at four of the DOE Labs**, to include at least one SC Lab, one NNSA Lab, and one of the applied energy Labs. Please choose Labs that have had LDRD programs for at least ten years.

In your review please consider each Lab's *processes* to:

- Determine the funding levels for the LDRD programs;
- Determine Lab-specific goals and allocate resources among the goals;
- Select specific projects; and
- Evaluate the success and impact of the LDRD program against Lab-specific goals and the overall objectives of the LDRD program over a ten-year period."

Subcommittee Composition:

- Advanced Scientific Computing Research Advisory Committee (ASCAC)
  - **Martin Berzins** (Utah)
  - **Tony Hey** (STFC, and UW)
- Biological and Environmental Research Advisory Committee (BERAC)
  - **Karin Remington** (Computationality, LLC.)
- Basic Energy Sciences Advisory Committee (BESAC)
  - **Dawn Bonnell** (U Penn.)
- Fusion Energy Sciences Advisory Committee (FESAC)
  - **Chris Keane** (WSU)
- High Energy Physics Advisory Panel (HEPAP)
- Nuclear Science Advisory Committee (NSAC)
  - **Karsten Heeger** (Yale)
- Defense Programs Advisory Committee (DPAC)
  - **Jolie Cizewski** (Rutgers)
- Environmental Management Board (EMB)
  - **Beverly Ramsey** (Desert Research Institute)
- Nuclear Energy Advisory Committee (NEAC)
  - **Joy Rempe** (Rempe and Associates)

High-level Overview of LDRD's "portfolio":

- Approximately 1700 projects per year: mixture of strategic and "blue sky" topics.
- About 4.54% of certified Labs' cost base in 2016.
- Average spend is $300k per project, with some variations.
- About 2000 papers and 400 inventions per year result.
- About 650 (2005) to 1034 (2016) postdocs fully or partially supported through LDRD.
- About 30% of all Lab post-docs fully/partially supported.
- Higher percentages of postdocs are supported at NNSA Labs
- Majority of LDRD projects include early career researchers.

Source: DOE Reports to Congress 2005 to 2015 and LLNL

Subcommittee Process:

- Subcommittee initially reviewed available **background information**, including:
  - Lab annual reports
  - Lab self-assessments already in place
  - Previous public reports related to LDRD, from GAO and Congressional Panels
- Six **full subcommittee planning teleconferences** from October through to December 2016.
- Several **calls to DOE and to Labs** were made during that timeframe to help clarify the charge and the site-visit schedules and agendas.
- Labs responded to a request for specific **advanced written responses** to certain questions to help **maximize the value of the site-visits**.
- **Subcommittee visits** to each of the 4 Labs
- 4 more **follow-up teleconferences, email**, and a **shared repository** to write the report.
- The individual Lab visit reports, to be included as Appendices, were **fact-checked** by the Labs before inclusion in the report.

All was done on a compressed timescale to meet ASCAC's April meeting deadline.

Subcommittee Lab Visit Schedule:

Subcommittee charge requested visits to four labs including one SC lab, one NNSA lab and one applied energy lab. These were arranged on the following dates in **early 2017**:

- Lawrence Berkeley National Laboratory: Wednesday, January 4th
- Lawrence Livermore National Laboratory: Thursday, Friday January 5-6*
- Oak Ridge National Laboratory Thursday: January 26th
- National Renewable Energy Laboratory: February 2nd

* Note: LLNL visit had a classified briefing that extended our visit

Overview of Lab Visit Structure:

Visits varied in format, but each followed a similar outline (by request):

- Lab Director's overview and LDRD overview for the Lab
- Lab Associate Directors' and leadership team members' presentations
- Poster session with LDRD researchers (and a panel session at LBNL)

  (Note: these were critical for understanding workforce issues)
- Discussions with LDRD Site Office staff
- Q/A sessions with Lab leadership

The Labs also provided the Subcommittee with the slides of their presentations for reference and use in our report.

Summary of Charge Responses:

What are the *processes* to determine the funding levels for the LDRD programs?

- These processes **balance the strategic needs** of the Lab **against the overhead burden** on other Lab funding.
- Differences reflect varying Lab missions and the need to **balance strategic research** against blue-sky high-risk research and fellowships to ensure recruitment.
- Great care is taken to address Lab strategic/operational needs within Congressional bounds.

What are the *processes* to determine Lab-specific goals and allocate resources among the goals?

- Each Lab has a slightly different process for goal setting, but all actively maintain their processes.
- An **informed high-level strategic view** taken by senior management **defines the goals and research areas** for calls for proposals to align the LDRD activities with Lab goals.
- Leaves room for **ground-up blue-sky** funding and **Lab fellowships** to introduce novel approaches that will contribute to and help shape evolving Lab priorities.

Summary of Charge Responses:

What are the *processes* to select specific projects?

- **Multi-level procedures** with the expended effort being proportional to the likelihood of funding and with feedback levels are used in a constructive approach to project selection.
- **White papers leading to full papers and presentations** are typically used in conjunction with mentoring to **reduce wasted effort.**
- The processes appear to be fair and well-managed with a strong developmental aspect that is both noteworthy and efficient in the long term.

What are the *processes* to evaluate the success and impact of the LDRD program against Lab-specific goals and the overall objectives of the LDRD program over a ten-year period?

- The procedures for evaluating success and impact include a **high-level federal process** and **detailed Laboratory processes**, with multiple levels of evaluation at different times.
- This includes external expert review and, for some of the Labs, **exit plans and post-project assessment over several years** (typically two to five), following the end of the project.

Summary of Charge Responses:

What is the impact of the LDRD program?

The Subcommittee observed the considerable and long-lasting impact of LDRD projects at a number of different levels:

- Traditional **research metrics** such as publications and patents, through to spin-off companies and follow-on DOE programs that continue to build upon the research led by LDRD.

- The use of LDRD to provide **fellowships for new hires** and **blue-sky research** has had a **profound impact** on the quality of both the research undertaken and the caliber of the Lab staff undertaking it.

- The LDRD program has allowed Labs to better accomplish their mission as well as allowing each Lab to **respond rapidly to emerging issues**, allowing the US to remain at the forefront of technology.

Observations, Recommendations and Best Practices:

- LDRD must be maintained at at least its present level to attract and retain the high-quality workforce DOE Labs currently enjoy.
- LDRD provides a mechanism to offer new and existing staff the opportunity to explore new challenges, while improving the research strengths of the Labs, meet current mission goals, and be prepared for future national challenges.
- LDRD is **essential** to maintaining the Labs Science Technology and Engineering (ST&E) base, both now and in the future.
- Longer-term LDRD fundamental research aimed at developing the new ideas and techniques will be **key to addressing future energy and national security challenges**.
- The Labs should introduce more **standardized** processes, (following lead of current best practices), to document and highlight the longer-term (> 5 year) impact of LDRD as a national asset. (e.g. consistent processes across Labs to track and understand the impact of projects and publications so that it is clear which LDRD projects led subsequent beneficial activities across the entire portfolio.)

Observations, Recommendations and Best Practices:

- There should be **informal LDRD coordination** to the extent possible between the SC Labs, such as presently exists amongst the NNSA labs; this will likely help increase the impact of LDRD across the Lab system and the related research communities.
- Some **LDRD best practices** at the Labs could be shared and deployed more broadly for mutual benefit.
- Encourage **"Lead reviewers" for all proposals**, with duties beyond simply reviewing the proposal, to include mentoring and follow-up.
- Encourage **"LDRD Points of Contact"** within the major Laboratory directorates, since they can play a critical role in ensuring program integration in all areas of the LDRD program.
- Each proposal should have:
  - a **pre-defined "exit" plan** to help maximize impact and minimize wasted effort,
  - a **succinct statement** of how the proposal benefits DOE, to be routinely included in the annual reports for LDRD.

Conclusions:

- LDRD Program provides a **unique combination of high-level laboratory driven strategic research and "blue sky", investigator driven, fundamental research** based upon individual innovation in a framework that has constructive federal, laboratory and external oversight at multiple levels.

- The LDRD program appears to be **very well run and monitored**, in accordance with the intent of the DOE program, and with processes that couple innovation at the Laboratory and individual scientist level with the Nation's anticipated future security, energy, science and engineering needs.

- Both the level of funding and the LDRD funding processes are appropriate and necessary for the Labs to continue to perform at their present high levels of R&D for the DOE.

- A more **systematic approach to monitoring the long-term impact** of the LDRD program at the Labs would make it easier for the great successes of the program to be more widely understood and appreciated.

Next: Finalizing the Report

- The **draft report of the subcommittee is openly available** as part of the meeting materials for this week's ASCAC meeting:

  https://science.energy.gov/ascr/ascac/meetings/201704/

- The report was presented, discussed, and **approved by ASCAC on Tuesday** this week (April 18th, 2017).

- The Subcommittee will be preparing the final version anon.