Importance of Collaboration

Workshop participants pointed to a number of reasons for collaboration between universities and national laboratories. Laboratories have an extensive investment by the federal government in facilities, equipment, and staff. This is very attractive for university researchers, who may not have access to major scientific facilities or to teams of researchers working on particular application areas. Another benefit of collaborative research is the broader problem set available to university researchers working with national laboratory teams. The laboratories were viewed by many as having a strong connection to real problems (the mission-oriented link) and yet still being close enough to academic research disciplines to have the ability to transfer their understanding to university situations. Laboratory staffs see universities as able to conduct research in a less constrained environment, driven less by mission and more by intellectual curiosity, enhancing their scientific productivity through the use of graduate students.

Several presenters from the laboratories reinforced the importance of university-laboratory collaborations. From the laboratory point of view, university collaborations at all levels are important to delivering world-class research and strengthening the overall contribution of the laboratories to the nation's research enterprise. In addition, the interaction with university researchers increases the quality and impact of the user facilities and helps to improve them. Finally, the opportunities to enhance the contributions of the laboratory to science education in the United States and to obtain access to top-level recruits were seen as additional benefits for the laboratory. Benefits to the universities include access to the world-

class user facilities and capabilities at the laboratories, and the potential for increasing the number of graduates from universities in critical science and technology (S&T) skills areas.

There are several forms of collaborative activity relative to the breadth of capabilities available at the national laboratories, particularly those with major user facilities. These were described by many of the presenters and include university faculty or students using a facility, joint research programs, joint educational programs, and at the highest institutional level, management contracts. Although each of these modes of interaction brings a number of benefits to both parties, most participants clearly identified the user facilities at DOE laboratories as one of the most important assets for the scientific community.

In the post-Cold War era, the DOE Office of Science (DOE-SC) national laboratories have become the major stewards of large-scale science capabilities that serve the entire U.S. scientific community. This stewardship function has grown rapidly together with advances in science and technology and is a significant role for DOE-SC. According to John Marburger, director of the Office of Science and Technology Policy (OSTP), the office spends approximately 40 percent on average of its programmatic funds on facilities operations. Additional funds are devoted to construction of new facilities. The rationale for continued federal investment in the laboratories is to ensure that these capabilities remain available to the U.S. scientific community.[1]

BENEFITS OF COLLABORATIONS TO UNIVERSITIES

The scientific facilities at the national laboratories and the unique instrumentation they provide are increasingly essential for university research groups to carry out their advanced scientific experiments in support of a broad set of science agendas. Some of the important benefits to universities from collaborations with national laboratories are noted below, taken largely from discussions at the Incentives and Structures breakout session at the workshop:

- **Science requiring large, complex facilities.** Universities generally operate through principal investigators and small groups who are not in a financial position to support large facilities such as the Advanced Photon Source at Argonne National Laboratory (ANL) and the teams of trained scientists and technicians required for effective and safe operation. Even if a university were in a position to fund a major laboratory, support for

[1]This section draws heavily on remarks presented by Michael Holland on behalf of John Marburger at the workshop.

operations within the university environment can be problematic. Most universities count on student labor in their labs, many of whom would not have the training required to operate some of these unique, multiuser facilities. Also, there is a lack of financial and career support for the technical staff at many universities, where the career ladder is focused principally around the teaching and research staff.

- **Science requiring substantial engineering and instrument development.** Science requiring substantial engineering projects (e.g., design of instrumentation or devices that allow new discoveries to be made) cannot generally be done in the university environment because such projects are not considered "thesis material" and because the appropriately trained engineering staffs are practically nonexistent.
- **Science requiring specialized, smaller facilities that are costly to maintain.** As an example, this might include the Combustion Research Facility at Sandia National Laboratories (SNL) or the High Temperature Materials Laboratory at Oak Ridge National Laboratory (ORNL). In general, it is difficult for universities to provide service contracts for equipment, since such costs are not allowed in grant proposals, or to hire and maintain the trained staff required to operate the equipment and maintain the facility. Furthermore, the "major research instrumentation" grants for which faculty can apply are generally limited to less than $2 million, leaving a wide range of technical devices and system capabilities that fall between the <$2 million university-based equipment options and the $100 million-$500 million required for a major national user facility. The national laboratories provide this intermediate ground of capabilities.
- **Expanded opportunities for interdisciplinary research, professional development and training.** Participants in the Incentives and Structures breakout session pointed to the difficulty for universities of building interdisciplinary teams within a single principal investigator reward system and the value of the laboratories in providing these opportunities for faculty and students. The laboratories also provide important opportunities for advanced training and continuing education of science and engineering (S&E) students and faculty through the opportunity to utilize specialized equipment or to be a part of a large, scientific team effort.

BENEFITS OF COLLABORATIONS TO LABORATORIES

The national laboratories are engaged in mission-oriented research that requires a broad range of scientific and engineering disciplines. Several presentations at the workshop described how the ability to integrate professors and their students into a research project extends the capability of a laboratory team and also provides a testing ground for attracting new staff. Collaboration with universities was also described as

providing a number of ancillary benefits to the laboratories (listed below), including a constituency for support of the continued mission of the laboratories and their functions.

- **Extension of capabilities to address key research questions.** Universities may have key capabilities and research facilities that are complementary to those of the national laboratories. National Science Foundation (NSF) funded centers or manufacturing-focused research centers are two examples. Collaborations between these institutions can open up entire new areas of science. This is illustrated by the experiences in the area of biology research, where we are now able to bring the tools of physics and chemistry to the life sciences in general and medical research specifically.
- **Conduct of peer-reviewed research outside the classified realm.** For scientists working in classified areas, collaboration with university programs and researchers provides opportunities to expand their career opportunities and strengthen their science through the conduct of peer-reviewed, open literature research. This independent verification of science results and the cross-fertilization of fundamental concepts between these worlds are important for researchers in the national laboratories and provide benefits to the broader scientific community.
- **Access to a diverse group of students.** The primary mission of the universities is education. Laboratories have the opportunity to expand and diversify their workforce by integrating students into their research programs. This also provides the laboratories with an important recruiting opportunity.
- **Political support for the continued missions and operations of the laboratory.** Collaboration and cooperation with universities constitute an important means for increasing political support for the laboratories. Universities need the facilities at the national laboratories to succeed in their missions and have been very vocal in their support for the user facilities. For example, of the 176 letters supporting increased FY 2004 budget requests for physical science, including the DOE Office of Science, 64 percent received were from university faculty or students.[2] University leaders are extremely influential on the political scene and are an important advocacy group for supporting the mission of the laboratories.

Most participants in the workshop reinforced the importance and benefits of a variety of research collaborations between universities and national laboratories. Of particular interest is access to the scientific user facilities at the laboratories. In addition, DOE remains the primary fund-

[2]Excerpted from Marburger's prepared remarks.

ing agency for physical science research; a significant fraction of the nation's expertise in areas such as neutron scattering, accelerator physics, and nuclear science resides within the national laboratories.[3] Yet DOE has had some difficulty enlarging its research budget to accommodate growth.

Some participants expressed concern that the lack of a clearly articulated DOE mission has contributed to the lack of political support for national laboratories, and this lack of support will present a significant challenge for future collaborative activities. The fact that both the National Institutes of Health (NIH) and NSF continue to have growing support for both facilities and research programs is viewed by some in the university systems as making it more difficult to develop, implement, and sustain collaborative research partnerships with the national laboratories. Nonetheless, the importance of finding ways to continue to build and maintain these relationships, particularly access to user facilities at the national laboratories, was viewed by most at this workshop as critical to their future endeavors. In fact, Marburger's comments, delivered by Michael Holland from OSTP, reinforced this point, stating that the laboratories are "helping the universities carry out their research mission for all of the science agencies."

While most agreed that these partnerships were important, they also agreed that there were a number of challenges to making these relationships work, even at the individual investigator level. These challenges, although not necessarily unique to collaborations between universities and national laboratories, nevertheless were viewed as important to deal with in order to increase the opportunity for successful collaborations. As noted by the title of the plenary session, if collaboration is such a good thing, why isn't there more of it?

Prepared remarks from key individuals were presented in four major areas of concern, followed by breakout sessions on each of these topics:

1. Incentives and structures
2. Access to major user facilities
3. Building the S&E workforce of tomorrow
4. Collaboration in the context of classified research

The following material represents the key items of discussion and major ideas presented during both the formal sessions and the breakout group discussions. Many of these same ideas are presented again in Appendix E, where they are grouped by types of collaboration.

[3]Excerpted from Marburger's prepared remarks presented by Michael Holland entitled, "On National Laboratory-University Collaborations."