DOE Best Practices Pilot Study

February 2002

BERKELEY LAB

LBNL/PUB-865

DOE Best Practices Pilot Study

February 2002

This work was supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

LBNL/PUB-865

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Executive Summary

Purpose and Approach

This Department of Energy (DOE) pilot study addresses the management relationships within national laboratories that are critical to operational efficiency and effectiveness in conducting DOE's science mission. Chartered by the Undersecretary of Energy and the Laboratory Operations Board Best Practices Working Group, the study identifies and assesses best management practices for consideration by the Secretary of Energy Advisory Board (SEAB). The recommendations include practices that might be incorporated into the Management and Operation (M&O) contracts for the national laboratories.

The pilot study compared best practices at federally funded research and development centers (FFRDCs) with those at Lawrence Berkeley National Laboratory (LBNL). LBNL was selected for the pilot because it has a focused science mission, conducts no classified work, and does not require unique and specialized administrative systems like those associated with nuclear materials, weapons development, or experimental reactors. The National Science Foundation's (NSF) National Center for Atmospheric Research (NCAR) and the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL) were selected for comparison with LBNL.

Under the charter guidance from the DOE senior management, the study was conducted by a team of administrative and operational specialists from LBNL, the University of California's Office of the President, DOE's Berkeley Site Office (BSO), and DOE's Oakland Operations Office. Data were gathered and analyzed from September through December 2001. This process included site visits, telephone interviews, and documentation from NCAR and JPL.

Key Findings: Aligning Relationships with Mission Objectives

Best practices are those management, administrative, or operational activities that enhance the ability of the organization to achieve mission success in a cost-effective and efficient way while providing the necessary assurances to the federal government that the contractor is a responsible steward of the public resources entrusted to it. Two different types of best practices were identified: those characterized by the nature of the relationship between the federal agency and the contractor, and those essentially internal to the contractor organization. Best practices in both of these areas lead to increased cost-effectiveness. The extent to which external and internal administrative and operational requirements have been aligned largely determines the efficiency of these laboratory organizations.

One of the most important findings was that the relationship between the federal agency and the contractor determines the extent to which this alignment is achievable. Where the federal mission program manager has the authority and responsibility for setting Administrative and Operational (A&O) requirements, alignment is achieved because the cost-effectiveness and efficiency gains are in the program manager's best interest. Where additional A&O requirements are directed from other parts of the agency that are not responsible for mission success, misalignment can occur, leading to increased costs and other inefficiencies. Alignment of mission and A&O requirements is fully achieved in the NSF–NCAR relationship, partially achieved through the NASA Management Office at JPL, and only minimally achieved in the DOE–LBNL relationship.

Despite some conflicts in the alignment between authority and responsibility in federal laboratory relationships, internal management continues to improve at the laboratories. Contractors using Performance-Based Management have undertaken streamlining, improved information systems, automated work processes, and modernized business practices. Innovative best practices of this type were identified at NCAR, JPL, and LBNL. For example, over the past decade, the University of California and DOE have employed performance-based management in the LBNL contract, which includes approximately 175 performance metrics. Steady improvement has been achieved in the A&O performance of LBNL, and costs of overhead functions have declined concurrently. However, further gains in cost-effectiveness and efficiency will depend on far better alignment of external and internal relationships. Thus, this document places considerable focus on the recommendations for best practices related to interactions between the federal agency and the contractor.

Best Management Practices and Recommended Changes

Alignment to achieve best management practices requires changes in roles and responsibilities on the parts of both the federal agency and the laboratory contractor. Moreover, a strong focus on mission success, throughout both the federal agency and the contractor organization, is a prerequisite for achieving the needed alignment between A&O requirements that support the scientific mission and other agency-driven A&O requirements. The best management practices summarized below address the realignment needs. Specific recommendations for new practices, with respect to the seven areas of inquiry chartered for this pilot study, are summarized in Table 1.

1. Line Management Accountability. Increase the focus on mission success by integrating A&O requirements into mission priorities, and establish line accountability within the program organization of the federal agency and throughout the contractor organization.

2. National Standards. Encourage efficient and innovative support work by establishing performance criteria that are based on applicable national standards instead of agency-specific requirements.

3. Assurance Reviews by External Experts. Enhance assurance and credibility of laboratory stewardship by using nationally recognized experts for A&O performance reviews and compliance audits.

4. Bilateral Decision Process. Tailor implementation of agency directives by taking site-specific conditions into account through a bilateral management decision process.

5. Performance Oversight and Incentives Based on Certified Systems Metrics. Replace transactional oversight of A&O performance with validation of certified systems, and base performance incentives on certified A&O system metrics.

6. Contract-Based Best Management Practices. Embody these best management practices in the FFRDC contract, defining the roles and responsibilities of agency and contractor personnel, behaviors, and performance expectations.

Benefits to the Department of Energy

Implementing the best management practices and adopting the recommendations described above would result in significant benefits to the DOE operations at LBNL. These mission-realignment and systems-improvement actions would allow labor reductions and cost avoidances—between 10% and 30% in net resource savings would be realized. The resources saved in A&O support areas could be immediately applied to critical mission and institutional needs. A sizable portion of the A&O cost savings would also be realized in the form of reduced indirect service budgets and corresponding lower overhead rates. The DOE missions and programmatic research facilities would be the direct beneficiaries of these redirected resources.

Best Practices Implementation

The Department of Energy and LBNL have an opportunity to gain significant improvements in mission performance and cost-effectiveness by instituting the best practices described in this document after verifying their efficiency through testing at LBNL. The LBNL effort could also serve the broader Laboratory Operations Board (LOB) Working Group study as a test bed for the applicability and efficacy of additional recommended improvements arising from other studies.

The "proof of principles" testing at LBNL would take place over a several-year period and include all of the elements described herein, beginning with a new contract between the University of California and DOE for operating LBNL. The contract would specify the terms and conditions of the testing, including a planning phase, a transition phase, an implementation phase, and an evaluation phase. As part of the test, we would put in place a set of measures to quantify the improvements in mission performance and the increases in cost-effectiveness and efficiency in LBNL, DOE, and UC laboratory management.

Table 1. Summary of the Recommended Best Practices for LBNL Adoption.

	Line Management Accountability	National Standards	Assurance Reviews by External Experts	Bilateral Decision Process	Performance Oversight and Incentives Based on Certified Systems Metrics	Contract-Based Best Management Practices
Laboratory Contract Management	Empower a single federal official responsible for mission and A&O success.	Use standard federal requirements and nationally recognized external standards for oversight.	Use recognized external experts for assurance reviews of systems.	Implement DOE orders in site-specific manner.	Use system-based metrics for performance and validation oversight. Strengthen line accountability with enhanced contract focus on mission performance.	Initiate a demonstration test to evaluate these concepts.
Implemention of Operations and Administrative Directives	Sustain and expand use of Field Management Council for setting new A&O requirements.			Adopt bilateral approach for evaluation and implementation of directives. Adopt a "work smart" procedure for all A&O.		
Business and Personnel Systems and Policy	Replace human resource procedural review with general agency oversight based on professional and industry standards.	Obtain administrative guidance from OMB circulars. Use fixed indirect cost rates. Conduct procurement under OMB Circular A-110.	Comply with the Single Audit Act.			Report inventory defined by the contract in a manner consistent with standard business practices.
Counterintelligence and Security	Use cost-benefit analysis for setting security requirements.	Use nationally accepted standards for security in unclassified settings.	Obtain independent risk and vulnerability studies from national experts	Allow local control and direction for security programs.	Use and enhance Integrated Safeguards and Security Management systems (ISSM).	
Environmental Health and Safety (EH&S)	Use EH&S performance reviews aligned to recognized performance-based management standards.	Adopt external standards for most general EH&S guidance.		Implement EH&S directives with bilateral agreement on appropriate methods and processes.	Use and enhance Integrated Safety Management (ISM) systems.	
Facilities and Infrastructure	Support facilities modernization and critical infrastructure by stronger DOE/SC "landlord" roles.				Continue use of contract performance metrics for infrastructure maintenance. Incentivize facilities maintenance subcontracts.	
Construction Project Management	Streamline and align with programmatic mission responsibility.			Tailor to regional and industry practices.		

Overview of the Best Practices Pilot Study

Introduction

The Department of Energy (DOE) has chartered a pilot study to assess current practices and make recommendations to improve laboratories' operational efficiency and managerial effectiveness. In 2001, President Bush presented a bold new strategy for improving the management and performance of the federal government. In *The President's Management Agenda*, he emphasizes the need to focus on results:

> *Government likes to begin things—new programs and causes and national objectives. But all good beginnings are not the measure of success. What matters in the end is completion. Performance. Results. Not just making promises, but making good on promises. In my Administration, that will be the standard from the farthest regional office of government to the highest office of the land.*
>
> **— George W. Bush**

The best practices identified in this study address several of the objectives spelled out in *The President's Management Agenda*:

- Emphasis on process will be replaced by focus on results.
- Organizations burdened with overlapping functions, inefficiencies, and turf battles will function more harmoniously.
- Management will show both flexibility and authority.

Adopting best practices that accomplish these objectives will lead to improved mission success through a greater emphasis on programmatic performance and cost-effectiveness.

The approach used here identifies and compares best practices of non-DOE federally funded research and development center (FFRDC) laboratories and assesses how DOE and its national laboratories can apply them. Expected outcomes from DOE implementation of best practices include the following:

- enhanced effectiveness and efficiency of laboratory research through reduction of unnecessary and costly requirements, clear line-management accountability, and an emphasis on obtaining more research value from each taxpayer's dollar
- enhanced laboratory environmental safety and health through a new streamlined approach to safety and improved oversight management

- improved contract specifications for operation of DOE laboratories
- improved operating efficiency of laboratories and programs through new and more flexible funding structures
- a well-defined path to drive change with a clear statement of where DOE stands and its vision for the future regarding the administration and oversight of its laboratories
- an improved relationship with Congress as DOE evolves an efficient and effective management system with a commitment to continuous improvement and clear lines of authority and accountability that will withstand the test of external examination
- a set of management principles and model practices for continuous improvement in the quality and quantity of oversight

Lawrence Berkeley National Laboratory was selected as the first DOE laboratory to undergo a best practices study. With an exclusively scientific research mission, LBNL has the advantage that it does not conduct any classified work. After this study is complete, laboratories that conduct some classified research and have a broader mission, including national security, may be evaluated. The National Aeronautics and Space Administration's Jet Propulsion Laboratory and the National Science Foundation's National Center for Atmospheric Research were selected for comparison to LBNL.

The purpose of this report is to provide information about the best practices identified at these three organizations to the LOB Working Group on Best Practices. The LOB Working Group will use the information in this report, along with other information, to make a set of recommendations to the Secretary of Energy Advisory Board (SEAB) about best practices that could be adopted by DOE.

A team of administrative, contractual, and operational specialists from LBNL and the University of California's Office of the President (UCOP) prepared the study report with assistance from DOE's Berkeley Site Office. DOE staff from the Oakland Operations Office participated in the design of this study. Data from JPL and NCAR were obtained through site visits and telephone interviews and from written documents. The study began in late September 2001 and concluded on December 31, 2001.

Scope of the Best Practices Study

The scope of information gathered for this project includes evaluation of management, contractual, administrative, and operational practices in the seven lines of inquiry listed below. In all of these areas, we also looked for management principles and model practices that encouraged striking the appropriate balance between administrative oversight and mission success. We also evaluated the nature and structure of the relationship between the federal agency and the contractor and

how this relationship influenced the effectiveness and efficiency of the organization. Finally, we evaluated how the contract itself helped to codify these principles and clarify the roles and responsibilities of the federal agency and contractor personnel.

Laboratory Contract Management. Examine various federal–laboratory contractual relationships. What are the expectations of the sponsoring federal agency, and how are they communicated to the laboratory? How is the laboratory held accountable for the work it performs and its operations?

Implementation of Operations and Administrative Directives. What are the requirements of the sponsoring federal agency, and how does the laboratory implement them? How are operations and administrative policies developed and implemented, and how are efficiency and effectiveness of implementation measured?

Business and Personnel Systems and Policy. How effective are the business systems, their scope, and their data requirements? What are the appropriate level and form of financial oversight and property management? How are they driving productivity improvements and cost savings?

Counterintelligence and Security. Examine the security measures required by the sponsoring federal agency and the roles and responsibilities of the federal agency (both field office and headquarters) and the laboratory. What level of counterintelligence presence and federal security oversight is provided at laboratories that do not perform classified research? What security measures and federal oversight are appropriate for a laboratory with little or no classified work?

Environmental Health and Safety (EH&S). Examine the roles and responsibilities of the federal government (both field office and headquarters) and the laboratory for EH&S. How is the EH&S function carried out? What is the appropriate level and form of oversight of EH&S? What standards and requirements exist and how are these determined?

Facilities and Infrastructure. Examine how infrastructure needs are identified, prioritized, and funded. What is viewed as the acceptable standard for infrastructure support, and how well is it maintained? What are the roles and responsibilities of the federal agency representatives (field offices and headquarters) and the laboratory? What are the requirements of the sponsoring agency?

Construction Project Management. What level of agency management and oversight is applied to major facility and construction projects? What are the project management requirements?

Description of Benchmark Organizations

Three laboratories were evaluated during this study: NCAR, JPL, and LBNL. All three organizations conduct scientific research and development programs and run user facilities for the scientific community. A single federal agency is the primary support for these laboratories, but each also carries out some work for other government agencies and private parties. Table 2 provides a snapshot of the three organizations. More detailed descriptions of these organizations, together with a description of the nature of their interactions with, and relationships to, their federal sponsors are provided below.

Table 2. Snapshot of the Benchmark Institutions.

Laboratory	Agency Sponsor	Annual Operating Budget	Number of Employees	Nature of Research	Site Security
NCAR	NSF	$160 M	1,290 1,250 FTEs	Atmospheric chemistry, solar physics, climate modeling, and societal impacts of climate and weather	Minimal physical security and cyber security No classified research
JPL	NASA	$1,300 M	5,200	Solar system exploration, space- and earth-observing systems, robotic technology for space exploration, computational sciences for assimilation of large databases, advanced instrumentation	Extensive physical security and cyber security Minimal classified research
LBNL	DOE	$430 M	3,830 2,915 FTEs	Fundamental research in bioscience and technology, materials sciences, advanced energy technology, chemical sciences, advanced detector systems, and environmental sciences	Moderate physical security, extensive cybersecurity No classified research

The National Center for Atmospheric Research

The National Center for Atmospheric Research is an open-site, multiprogram research institute housed mainly in two locations in Boulder, Colorado: I.M. Pei's Mesa Laboratory and a newer Foothills Laboratory. The National Science Foundation is the primary sponsor of NCAR. A 66-member consortium of universities called the University Corporation for Atmospheric Research (UCAR) provides management and oversight under a cooperative agreement with the NSF.

NCAR was established in 1960 with a core team of five scientists. Since that time, it has expanded to a $160-million-per-year operation with a staff of 1,200, including 120 Ph.D. researchers who conduct inquiries into a wide range of atmospheric research topics, including

- atmospheric chemistry, focusing on the photochemistry of the troposphere, biosphere/atmosphere interactions, and middle atmospheric dynamics and chemistry, as well as climate/chemistry couplings
- solar physics, studying the connections between the sun and the Earth's atmosphere and physical environment, the physical processes that produce variable solar output, and the influence of these variations on the dynamics, chemistry, and electrodynamics of Earth's middle and upper atmosphere and near-space environment
- climate modeling, seeking to understand Earth's climate system and to develop the capability of predicting its evolution through studies of the climate system's components—atmosphere, oceans, land surface, sea ice, and biogeochemistry—and the development of models to realistically simulate the Earth system
- the societal impacts of climate and weather, including integrated research on the societal implications of atmospheric and related environmental processes and the interactions among society, the atmosphere, and natural systems, focusing on climate and severe weather impacts on industry and natural resources

Hundreds of researchers come to NCAR each year to interact and collaborate with these scientists, using their vast array of atmospheric and geoscience instruments. In addition, NCAR is a supercomputing center, supporting the work of university researchers from around the world through the Internet, and providing state-of-the-art scientific visualization capabilities. It is also a key contributor and collaborator on many worldwide field investigations of various atmospheric issues and phenomena.

The National Center for Atmospheric Research is one of five FFRDCs sponsored by NSF. As an FFRDC, NCAR's NSF support and its key role in NSF's geosciences mission and research infrastructure have led to a very positive and close partnership with NSF line management. The NSF oversight of UCAR's manage-

ment and NCAR's programs, administration, and operations is provided by a staff of four NSF employees located at NSF Headquarters. There are no federal employees located at NCAR, nor is there a management office located in the vicinity. Principal management and oversight relationships between NSF and NCAR are illustrated in Figure 1. The NSF Program Manager is responsible for oversight of the cooperative agreement, funds, and operating rules. The simplicity of this arrangement and the alignment of the agreement, funds, and rules with the scientific mission through a single point of contact at NSF Headquarters create an environment where A&O activities can be accomplished effectively with optimum cost-efficiency.

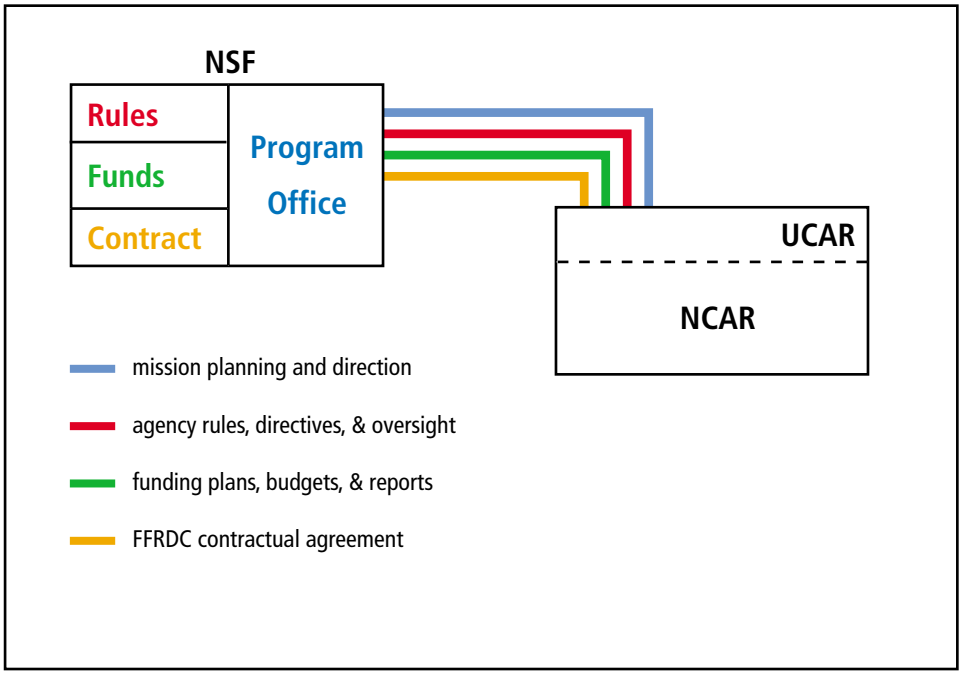

Figure 1. Lines of management, administration, and oversight in the relationship between NSF and NCAR.

The Jet Propulsion Laboratory

The Jet Propulsion Laboratory, managed by the California Institute of Technology (Caltech), is NASA's current lead center for robotic exploration of the solar system. Its space crafts have visited all the planets in our solar system, except Pluto. Its telescopes are observing distant galactic bodies in the universe to study how our solar system formed. The laboratory also manages the worldwide Deep Space Network, which communicates with spacecraft and conducts scientific investigations from its worldwide facilities in California's Mojave Desert near Goldstone; in Madrid, Spain; and in Canberra, Australia. Its cameras and sensors are aboard satellites circling Earth to study atmospheric ozone, oceans, and other earth sciences. To sup-

port this continued exploration, JPL is making advances in technology with new instruments and computer programs to help our spaceships conduct more complex missions and allow our telescopes to see deeper into space.

In addition to being a center for robotic space exploration, JPL has applied its innovative technologies to such projects as

- Firefly—an aircraft-borne, infrared, fire-mapping system for the U.S. Forest Service
- a document-monitoring system to help the National Archives safeguard the U.S. Constitution, the Declaration of Independence, and the Bill of Rights
- medical projects, such as robot-assisted microsurgery
- massively parallel computers to support processing of enormous quantities of data to be returned by space missions in years to come

The Jet Propulsion Laboratory's history dates to the 1930s, when Caltech professor Theodore von Kármán conducted pioneering work in rocket propulsion. The success of these endeavors led to the U.S. Army Air Corp's funding von Kármán and Caltech for a technical analysis of the German V-2 program, at that time just discovered by Allied intelligence; later funding was provided for a U.S. research project to understand, duplicate, and reach beyond the German guided missiles. In the proposal, the Caltech team referred to their organization for the first time as "the Jet Propulsion Laboratory."

Subsequent Army work further sharpened the technologies of rocketry, communications and control, design and testing, and performance analysis. This made it possible for JPL to help develop flight and ground systems and finally to help launch the first successful U.S. space mission, Explorer 1, in 1958. When Congress created NASA in 1958, JPL was transferred from Army jurisdiction to a contract relationship with the new civilian space agency.

The Jet Propulsion Laboratory today employs approximately 5,200 people at three major sites in southern California and at NASA sites worldwide. Approximately two-thirds of the JPL workforce have graduate, postgraduate, and professional degrees and work in space science, space exploration, and space transportation. The JPL annual budget is about $1.3 billion, with NASA being the major funding organization.

The Jet Propulsion Laboratory is the only NASA-sponsored FFRDC. Similarly, JPL is the only FFRDC operated by Caltech. As such, operating and administrative requirements are unique to JPL. Principal NASA interactions and interfaces with Caltech and JPL are illustrated in Figure 2. The contract, funds, operating rules, and research programs are set by NASA Headquarters. An onsite NASA Management Office is responsible for negotiating and managing the contract, overseeing A&O activities, and negotiating whether and how NASA Issuances (the equivalent of DOE Directives) are implemented. The JPL contract includes task orders for all major R&D activities. The presence of the onsite NASA Management

Office creates an operating environment with clear lines of authority and accountability between the federal agency and the contractor. There are 23 employees in the NASA Management Office. In addition, there are 11 employees from the Defense Contractor Audit Agency (DCAA) and 15 employees of the Inspector General (IG) located onsite. All 11 members of the DCAA are focused on audits of JPL. The IG's Office responds to a broader set of issues and is not focused exclusively on JPL. The laboratory is located about five miles from the Caltech campus. The university and laboratory work together closely and, in some cases, use shared staff. The close working relationship between JPL and Caltech leads to efficient and cost-effective reporting and oversight of JPL, through the NASA Management Office.

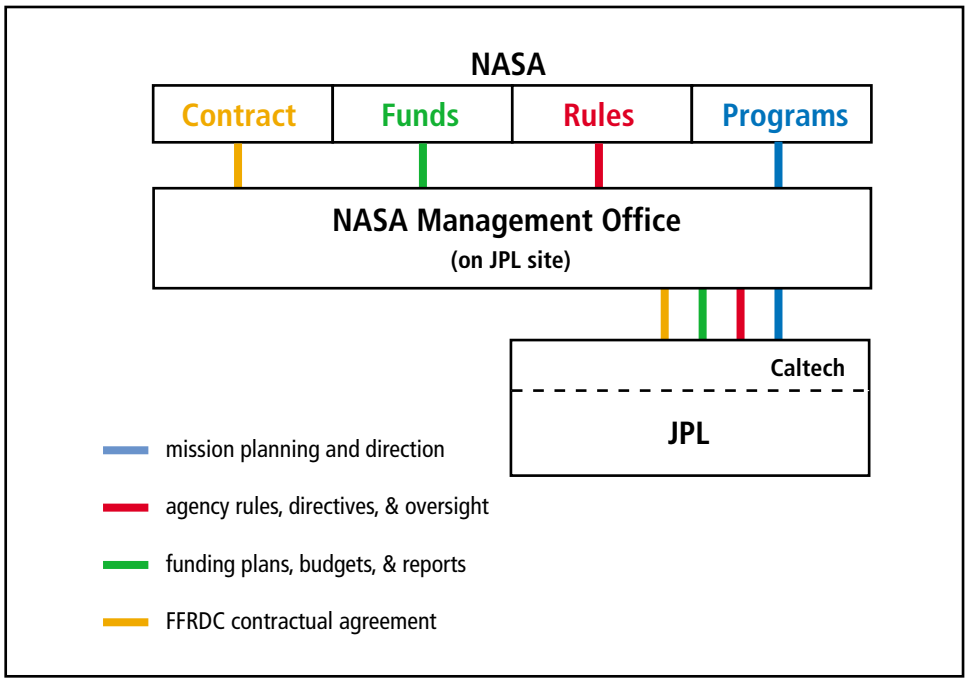

Figure 2. Principal NASA interfaces with JPL for management, administration, and oversight.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory is a multidisciplinary national laboratory in the DOE complex that conducts nonclassified research. Ernest Orlando Lawrence founded the laboratory in 1931. It is the oldest of the DOE national laboratories, and it has had nine Nobel Prize winners on its research staff, the first being Ernest Lawrence for his invention of the cyclotron. Over the past 70 years, LBNL has evolved from the birthplace of nuclear science and medicine into a multiprogram DOE science laboratory. The laboratory is a part of the University of California and has core competencies in the following areas:

- bioscience and biotechnology: structural biology, genome research, bioinstrumentation, medical imaging, biology of aging and human diseases, biomolecular design, and environmental biology
- characterization, synthesis, and theory of materials: advanced spectroscopies and microscopies based on photons, electrons, and scanning probes; ceramics; alloys; heterostructures; superconducting, magnetic, and atomically structured materials; bio-organic synthesis; nanotechnology; and studies of complexity
- advanced technologies for energy supply and energy efficiency: subsurface resources and processes, building technologies, electrochemistry, fossil-fuel technologies, and energy analysis
- chemical dynamics, catalysis, and surface science: reaction dynamics; photochemistry of molecules and free radicals; surface structures and functions; and heterogeneous, homogeneous, and enzymatic catalysis
- advanced detector systems: major detectors for high-energy physics, nuclear science, and astrophysics; scientific conception and project leadership; advances in particle and photon detection; and implementation of new concepts in detector technology
- environmental assessment and remediation: advanced instrumentation and methods for environmental characterization and monitoring, human health and ecological risk assessment, indoor air quality, subsurface remediation of contaminants, geologic isolation of high-level nuclear waste, and actinide chemistry

The laboratory is also the home of four national user facilities, which act as resources for the national and worldwide scientific community: the Advanced Light Source, the National Center for Electron Microscopy, the National Energy Research Scientific Computing Center, and the 88-Inch Cyclotron.

Today, LBNL has an annual budget of over $430 million and employs some 3,800 staff members in work facilities in the California cities of Berkeley and Oakland and on the UC Berkeley campus. Its proximity to UC Berkeley has fostered research and educational relationships for decades. Many LBNL scientists hold dual appointments at LBNL and UC Berkeley. Annually, LBNL hosts up to 2,000 research collaborators as visiting scientists at its research facilities. Students from the University have always been a part of LBNL research programs, are mentored by LBNL scientists, and bring their energy, fresh approach, and new ideas to all of the laboratory's research areas.

The DOE funds over 78% of LBNL's work, its Office of Science (DOE/SC) being the principal DOE sponsor and mission manager. The DOE/SC has onsite representation by BSO, which has a staff of 16 and reports to the SC Director. DOE/SC is also the Lead Program Secretarial Office (LPSO) for LBNL. In this role, SC has principal federal responsibility for the laboratory's institutional planning, program integration, infrastructure stewardship, and overall DOE management of the contract and the facility.

The principal lines of management, business interfaces, communications, and A&O oversight between DOE and UC/LBNL are shown in Figure 3. DOE administrative and policy offices also use representatives from DOE Headquarters and the National Nuclear Security Administration's (NNSA) Oakland Operations Office for interfacing with LBNL. The complex and convoluted nature of this arrangement leads to a lack of clear lines of authority, confused roles and responsibilities, overlapping and redundant administrative work, duplicative and contradictory oversight, and increased administrative and operating costs.

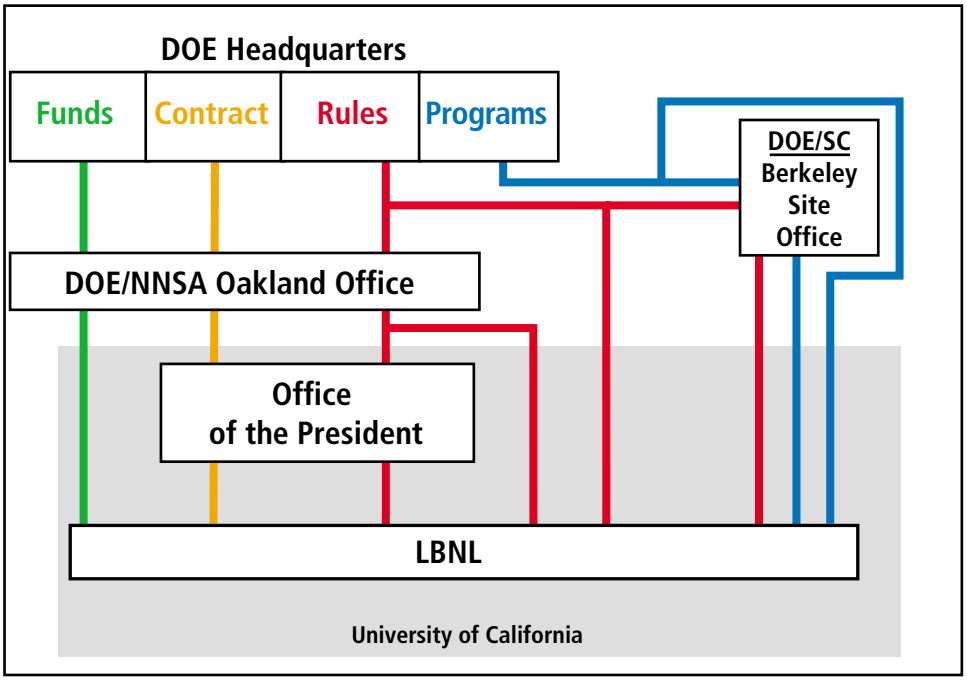

Figure 3. Principal management lines, business relationships, communication interfaces, and A&O oversight roles between DOE and LBNL.

What Is a Best Practice?

For the purposes of this study, the term "best practice" is defined as

> a management, administrative, or operational practice that enhances the ability of the organization to achieve mission success in a cost-effective and efficient way while providing the necessary assurances to the federal government that the contractor is a responsible steward of the public resources entrusted to it.

Best practices can be recognized in a number of ways, including quantitative metrics about cost, timeliness, and quality; professional judgment; comparison to external standards; anecdotal evidence from the comparison of past and current per-

formance; and peer review. This study is based on a combination of these approaches, relying whenever possible on quantitative metrics. However, the complexity of these organizations, including the common practice of using a combination of centralized, distributed, and outsourced staff, makes it extremely difficult to provide reliable quantitative comparisons between these organizations. Often, statistics that would support such a comparison are not available. Therefore, in many instances we have had to support the assertion of a best practice by relying on other means. Nevertheless, we have included as much quantitative information as we could obtain in the time allotted to this study.

Two different types of best practices are identified in this study: (1) those that are characterized by the nature of the interaction and relationship between the federal agency and the contractor, and (2) those that are essentially internal to the contractor organization. In essence, the administrative and operational infrastructure of each laboratory is organized and sized to meet two sets of requirements: those that are internal to the organization and those that are external. Best practices in both of these areas can lead to increased efficiencies and cost-effectiveness. More importantly, the more extensively the external and internal administrative and operational requirements are aligned, the more cost-effective and efficient the organization can be.

One of the most important conclusions from this study was that the interaction and relationship between the federal agency and the contractor determine the extent to which this kind of alignment is achievable. Where the federal mission program manager has the authority and responsibility for setting A&O requirements, alignment is more directly achieved because the cost-effectiveness and efficiency gains are in the program manager's best interest. Where additional A&O requirements are directed from other parts of the agency that are not responsible for mission success, misalignment can occur, leading to increased costs and other inefficiencies. This important concept is illustrated by comparing the organizational relationships shown in Figures 1 through 3. Integration between mission and A&O requirements is fully achieved in the NSF–NCAR relationship, partially achieved through the NASA Management Office at JPL, and only minimally achieved in the DOE–LBNL relationship.

Best practices that are internal to the contractor organization are typically used to improve work processes through streamlining, improving information systems, automating work processes, and adopting modern business practices. Innovative best practices of this type were identified at LBNL, JPL, and NCAR. Over the past decade, the University of California and DOE have employed performance-based management of the LBNL contract. Appendix F of LBNL's contract lays out about 85 performance measures, which are further discretized with individual goals, measurement protocols, and evaluation procedures. In addition, a large number of contract measures have subelement requirements such that the total metrics count approaches 175. Many of these performance metrics are based on best industrial practices, and scoring criteria are evaluated against industry benchmarks. As shown in Figure 4, steady improvement has been achieved in the A&O performance of LBNL, and costs of overhead functions have declined concurrently. As shown, the

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"The biggest gains in cost-effectiveness and efficiency will not be gained from improved practices that are internal to the contractor organization. Instead, there must be a focus on those best practices related to the relationship between the federal agency and the contractor."

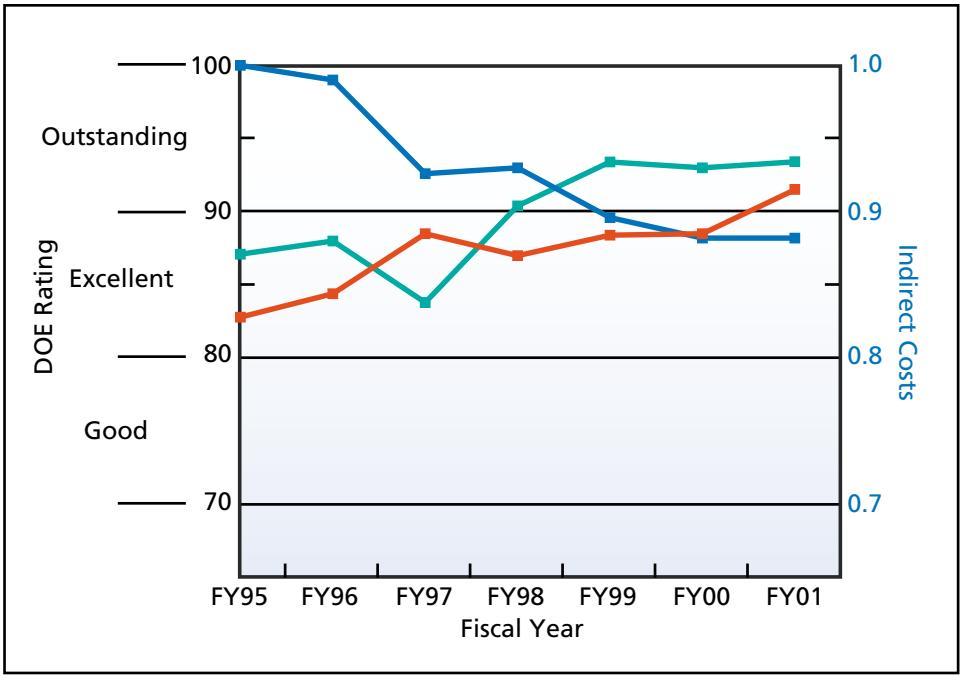

Figure 4. Trends in LBNL performance ratings and laboratory overhead costs: *green line,* science and technology performance rating; *red line,* performance in administration, management, and operations; *blue line,* compound overhead normalized to FY 1995.

performance of LBNL is now judged to be "outstanding" by this set of metrics. For this reason, the biggest gains in cost-effectiveness and efficiency will not be gained from improved practices that are internal to the contractor organization. Instead, there must be a focus on those best practices related to the relationship between the federal agency and the contractor.

Overview of Best Practices and Recommendations

The excellent reputations and performance records of NCAR and JPL were evident in the various best business and operational practices identified during this study. Best practices were also identified at LBNL. In this section of the report, we highlight the best practices and summarize the information presented in greater detail in the chapters that follow.

During the identification and analysis of data for this study, a set of best FFRDC management practices emerged. Application of these best management practices at the benchmark organizations provided evidence for the improved efficiencies, cost-effectiveness, and accountability sought by DOE. Importantly, all of these best management practices require changes in roles and responsibilities, behaviors, and expectations on the part of both the federal agency and the laboratory contractor. Moreover, a strong focus on mission success, throughout both the federal agency

"All of these best management practices require changes in roles and responsibilities, behaviors, and expectations on the part of both the federal agency and the laboratory contractor."

"A strong focus on mission success, throughout both the federal agency and the contractor organization, is a prerequisite for achieving the needed alignment between A&O requirements that support the scientific mission and other agency-driven A&O requirements."

and the contractor organization, is a prerequisite for achieving the needed alignment between A&O requirements that support the scientific mission and other agency-driven A&O requirements. These two observations are the foundation for all the recommendations presented in this report.

In the following paragraphs, six best management practices are presented, along with specific recommendations for implementation in the areas of contract management, implementation of agency directives, EH&S, business and personnel systems, security, construction projects, and infrastructure management. In the chapters that follow, more detailed descriptions of the recommendations and supporting arguments for identifying them as such are provided.

The effect of implementing this full suite of best practices at LBNL would be large—both in the challenges offered to management and in the potential benefits for the program. For reasons stated earlier, this study's conclusions are not entirely supported by quantitative data; however, a quantification of the potential efficiencies to be realized from the recommended practices has been completed. The estimated A&O savings within LBNL for the study areas are on the order of 10% to 30%. Although these numbers are first-order estimates, the potential improvement in effectiveness and efficiency demands an open and thoughtful consideration of the study's recommendations and a testing of the best management practices outlined below.

1. Line Management Accountability. Increase the focus on mission success by integrating A&O requirements with mission priorities, and establish line accountability within the federal agency's program organization and throughout the laboratory.

For improved mission success and enhanced laboratory effectiveness, line management must be accountable for both direct mission work and supporting A&O work. The work requirements for A&O must be integrated with, and coordinated through, the line management chain, beginning with line management inside the agency. Numerous examples at NCAR and JPL substantiate this principle. Their common and most noteworthy best management practice is the provision for a mission-focused agency office that provides for balanced and coordinated integration of both A&O and program work priorities. In addition, the same office ensures that the contractor meets government performance criteria in a similarly integrated manner. At JPL, this role is played by the onsite NASA Management Office—a focus for communication and coordination on all subjects with JPL's diverse program clients, project collaborators, and stakeholders. At NCAR, the focus is the Geosciences Program Office at NSF Headquarters.

The laboratory looks to the mission integration office for all substantive communications, operating authorities, and performance oversight. Through the mission office, the federal agency speaks with a single authoritative voice. Similarly, the laboratory's work responsibilities and performance commitments are monitored and evaluated in a balanced and integrated manner.

We recommend that this best management practice be implemented at LBNL by significant reorganization of the relationship between DOE's Office of Science and LBNL. The proposed organization is shown in Figure 5. Primarily, this reorganization would place the DOE Site Office in a strengthened line management role. Reporting to the Director of DOE's Office of Science, the Site Office Manager would be accountable for the field execution of assigned programs and projects and those A&O support functions needed for successful mission implementation. This reorganization provides for a single individual in DOE to integrate mission needs with A&O requirements and would achieve the resulting benefits observed at NCAR and JPL. The Site Office would have a small, highly qualified staff to carry out its responsibilities. The number of staff members is uncertain, but experience from JPL suggests that fewer than 25 would be sufficient. To achieve effective oversight in a cost-effective way, the Site Office must move from transaction oversight by in-house federal staff to approval of certified systems that are evaluated through external audits and peer reviews.

"To achieve effective oversight in a cost-effective way, the BSO must move from transaction oversight by in-house federal staff to approval of certified systems that are evaluated through external audits and peer reviews."

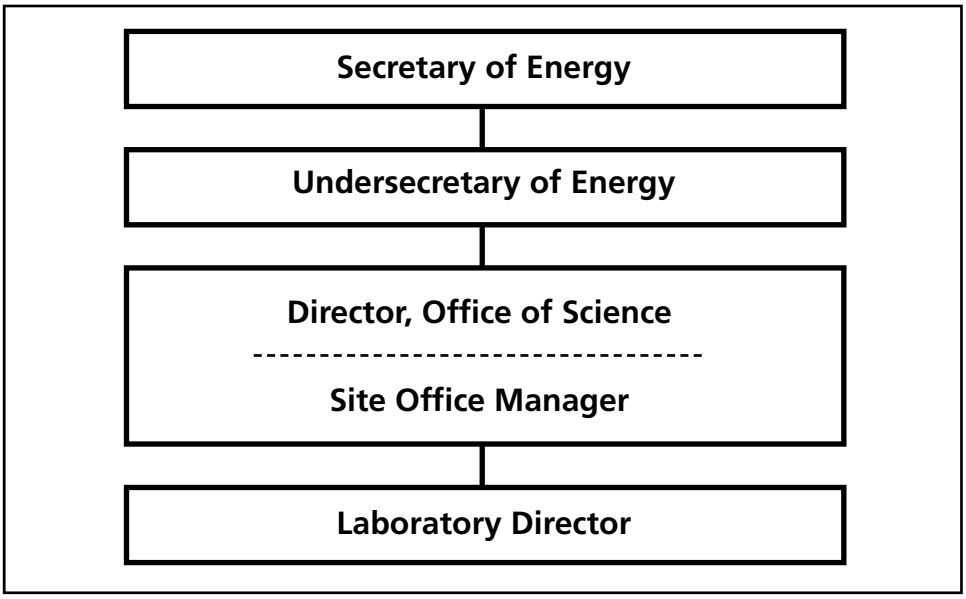

Figure 5. Proposed operational lines of authority and accountability.

In addition to these proposed organizational changes, we also recommend a number of other changes that are consistent with these best management practices:

- Sustain and reinforce the role of DOE's Field Management Council for authorizing new A&O requirements.
- Replace agency reviews of human resource practices and decisions with annual performance oversight by the BSO.

- Use cost-benefit analysis for setting physical security and cybersecurity requirements.
- Replace direct federal oversight ("operational awareness") of EH&S with performance-based reviews.
- Streamline and align construction project management with programmatic mission responsibility.
- Strengthen "landlord" role to better support facility modernization and mission-critical infrastructures.

2. National Standards. Encourage efficient and innovative support work by establishing performance-based criteria using applicable national standards instead of agency-specific requirements.

Many federal agencies have realized significant benefits by moving from agency-specified work criteria to appropriate and applicable work requirements drawn from national, commercial, or professional practices. Nationally accepted work standards bring proven efficiencies, innovative methods, experienced personnel, shared innovations, tested technologies, and opportunities for professional skills advancement to the laboratory workplace. Laboratories working to mandated agency-specific criteria cannot improve at the pace of the nation's professions and commercial enterprises.

Both JPL and NCAR primarily use nationally recognized work standards for mission support activities. Both agencies encourage this application of appropriate best business practices by limiting the number of agency-authored work directives and by rewarding laboratory A&O system improvements and innovations. Accordingly, NCAR and JPL demonstrated numerous best work practices—either adopted from or based on well-publicized national business standards. LBNL has implemented two noteworthy innovations (line management of safety responsibilities and streamlined property inventory processes) with special DOE authorization.

We recommend the following changes to achieve this best management practice at LBNL:

- Specify in the LBNL contract that standard federal requirements for contractors and national business standards should be used for administration and operations.
- Use OMB circulars for providing administrative and operational requirements.
- Use fixed indirect cost rates with a provision for efficiently managing differences in indirect cost budgets.
- Use OMB circular A-110 (rules for nonprofit organizations) for procurement.
- Adopt external standards for regulating EH&S, where feasible.

3. Assurance Reviews by External Experts. Enhance assurance and credibility of LBNL stewardship through use of nationally recognized experts for A&O performance reviews and compliance audits.

The adoption of nationally standardized A&O requirements and practices gives the laboratory an opportunity to improve the levels of assurance and credibility in its stewardship of important resources and systems. Several team members noted excellent work practices in this area, which resulted in reduced risk and enhanced credibility for the laboratory's management of government resources and facilities. Stewardship duties, when employing standard work systems, can be significantly enhanced through audits, reviews, and evaluations conducted by an appropriate and complementary combination of recognized experts, internal audits, and performance-based management tools. The expert services are obtained by contract with commercial firms or by peer panels. The quality and consistency of available expertise is much improved, and the credibility of review findings is significantly strengthened by the source being external to DOE and LBNL interests.

With the implementation of national standards, the contractor's assured compliance is generally assessed at the systems level. Systems assurance reviews may use external experts in combination with self-assessment reports of systems-based metrics. Such systems-based metrics can be effectively benchmarked against best industry practices and nationally recognized metrics for best-in-class systems (e.g., OSHA's VIPP and EPA's IS14001).

We recommend the following changes to achieve this best management practice at LBNL:

- Specify in the LBNL contract that nationally recognized external experts will be used to audit, review, and evaluate the compliance of A&O processes and systems.
- Comply with the Single Audit Act for business and personnel systems.
- Perform independent security risk and vulnerability studies using national experts.

4. Bilateral Decision Process. Tailor implementation of agency directives by taking site-specific conditions into account through a bilateral management decision process.

Federal policy authors usually do not have the field knowledge or site operational experience to reflect laboratory-specific characteristics when designing unique departmental work requirements. Consequently, new directives may be difficult and costly to implement, especially if they are prescriptive about how they should be implemented, as opposed to being prescriptive about the result they are designed to achieve. In addition, a steady stream of new agency directives leads to a continually changing set of A&O requirements. The resulting instability and uncertainty

lead to an inefficient use of resources and increase operating costs. Moreover, verbatim compliance often is costly, may be inappropriate for a specific site, and can be counterproductive to the mission. This impasse is overcome when a mission-responsible agency representative and the contractor work as partners in designing approaches to compliance issues and solutions to site-specific problems. Policy should be focused on expectations and outcomes instead of processes.

Both NCAR and JPL have significant input into when, whether, and how directives are implemented. The JPL contract specifies the following:

> The parties hereto agree that NASA Management Directives Systems publications ("NASA Issuances") are not in and of themselves applicable to the Contractor, and that the Contractor therefore is not obligated merely by virtue of their issuance to implement their intent or to observe the policies and procedures set forth therein, irrespective of the fact that certain NASA Issuances may apply to JPL. NASA Issuances become contractually binding and obligatory upon the Contractor only when and to the extent made so by appropriate contractual means.

The contract then lays out a process whereby the contracting officer and the contractor agree to evaluate the applicability of new NASA Issuances and bilaterally modify the contract to reflect these new operating requirements, if mutually agreed upon. At NCAR, the applicable federal policies and procedures are integral to the clauses in the cooperative agreement, and these are negotiated only once every five years as part of the contract renewal.

We recommend the following changes to achieve this best management practice at LBNL:

- Incorporate language into the LBNL contract that allows flexibility to negotiate with the BSO to develop site-specific implementation of federal requirements.
- Adopt JPL language for the implementation of directives (see above).
- Adopt a "work smart" procedure for all administrative and operational activities.
- Employ local control and direction for site security programs.
- Ensure bilateral agreement on how EH&S directives are implemented.
- Tailor construction project management to regional standards and industry practices.

5. Performance Oversight and Incentives Based on Certified Systems Metrics. Drive improved mission success by systems-based validation processes for certified EH&S and business operations in place of current federal oversight by transactional review.

Performance-based management has succeeded in improving the quality of A&O work efforts while driving down costs at LBNL. Figure 4 demonstrates that LBNL

improved its A&O performance rating, as evaluated by DOE, from a low "excellent" to an "outstanding" between 1995 and 2001. At the same time, it reduced overhead costs by 12%. Similar successes through the award fee determination process have been documented at JPL. Through the improved quality of A&O support at lower costs, mission success is improved by having a larger fraction of the available resources go directly to support mission-critical activities.

To drive continued performance effectiveness, the performance-based management process must be enhanced by shifting to higher-level contract metrics that assess the full range, complexity, and interdependence of support systems. This will encourage more initiative and innovation in driving down nonmission costs and improving performance, while allowing the incorporation of system metrics validation to replace costly transactional oversight. Managers need the flexibility to optimize system performance. Additionally, LBNL's existing performance-based management system is very expensive to carry out, with an estimated effort of more than 10 full-time employees (FTEs) at LBNL and a similar effort in the offices at UCOP, BSO, and OAK. A streamlined approach that focuses on fewer systems-level metrics would provide greater value and more balanced institutional assurances of A&O performance and compliance with oversight criteria.

The successful implementation of a performance-based management process also requires that the accompanying reward system acknowledges the shared goals inherent in an FFRDC partnership, reinforces the common interests of the federal agency and the laboratory, holds the contractor accountable for poor performance, and rewards the laboratory and contractor management for performance excellence with incentives of meaning and value to their institutional culture. For example, the management of UCAR/NCAR is engaged at present by NSF's "extend/compete" evaluation and decision process, which puts NCAR in the appraisal spotlight and rewards positive evaluations with a continued contract to carry on the NSF–NCAR mission. Outstanding performance at JPL is recognized by NASA with an award fee of up to $22 million. The amount given is based on a scoring system that is weighted 65% by program performance, 25% by institutional performance (A&O), and 10% by outreach activities. At LBNL, a program performance award fee, with a maximum of $1.6 million, is given for outstanding performance. The scoring is weighted 50% by program performance, 40% by A&O, and 10% by management. The laboratory may use the program performance fee for University Directed Research and Development (UCDRD) if it is not needed to pay unallowable costs. The UCDRD program provides a strong incentive for LBNL to minimize unallowable costs. Additional innovative approaches, such as those listed below, could provide cost-effective ways to further incentivize the LBNL contract.

We recommend the following changes to achieve this best management practice at LBNL:

- Incorporate systems-based validation processes and certified systems metrics into the LBNL contract.

- Enhance the use of Integrated Safety Management (ISM) by working to nationally recognized standards and oversight based on system self-assessments.
- Continue and enhance the use of Integrated Safeguards and Security Management (ISSM).
- Strengthen LBNL contractor management accountability by: incentivizing each year of outstanding performance with a one-year contract extension (up to a maximum of five one-year extensions to the basic five-year contract) and recognizing unsatisfactory performance with a one-year reduction of the contract's term; and placing more emphasis on program performance.
- Appropriately incentivize facilities maintenance and other support service subcontracts.

6. Contract-Based Best Management Practices. Embody these management principles in the FFRDC contract, fully defining the roles and responsibilities of agency and contractor personnel, behaviors, and performance expectations.

Contractually specifying the roles and responsibilities, performance expectations, and behaviors of both the contractor and the federal sponsor provides a strong foundation to create the kind of relationship needed to increase accountability, cost-effectiveness, and performance. Examples of this best practice were found in some elements of the NCAR, JPL, and LBNL contracts. For example, the NASA–Caltech contract clearly specifies the roles, responsibilities, behaviors, and performance expectations for federal and contractor personnel with regard to NASA Issuances. Another clear example is the unambiguous language by which the NSF–UCAR cooperative agreement defines roles and responsibilities for federal and laboratory personnel. One of the many noteworthy instances in their contract occurs in the first clause, which calls upon NCAR to

> . . . take responsibility for the conduct of the project or activity supported under this agreement and for adherence to the agreement conditions. Although the awardee is encouraged to seek the advice and opinion of the NSF on special problems that may arise, such advice does not diminish the awardee's responsibility for making sound scientific and administrative judgments and should not imply that the responsibility for operating decisions has shifted to NSF.

The contract then refrains from dictating work methods and procedures to laboratory management.

We recommend that this best management practice be implemented by writing LBNL's contract to include the principles laid out here, including clearly specifying the roles and responsibilities, performance expectations, and behaviors of the contractor, the BSO, and DOE Headquarters staff. In addition, the contract should include the set of principles by which the laboratory operates, so as to codify the agreements reached during the development of the contract. This will provide a

benchmark against which DOE's Office of Science can determine how to respond to future requests for changing A&O requirements. In addition, we also recommend the following changes to achieve this best management practice at LBNL:

- Initiate a project to test and evaluate the Best Management concepts at LBNL.
- Incorporate an agreed-to inventory of annual or quarterly business and human resources reports into the contract, consistent with standard business practices.

Benefits to the Department of Energy

Implementing the best management practices and adopting the recommendations described above would result in significant benefits to the DOE operations at LBNL. Even though large-scale A&O process reengineering efforts were taken at LBNL in the 1990s, and these resulted in considerable support cost and staff savings, these new mission alignment and systems improvement actions would allow even more cost and labor avoidances. A conservative estimate of the potential resource savings is between 10% and 30%, to be accrued in a relatively short period. The resources saved in A&O support areas could be immediately applied to critical mission and institutional needs. Long-standing needs include modernization and upgrading of research facilities; renewal of infrastructure and mission-related equipment; control of indirect cost factors such as inflation and escalated site stewardship expenses; and development of program and support personnel. A sizable portion of the A&O cost reductions would also be realized in the form of reduced indirect service budgets and corresponding lower overhead rates.

Implementing and Testing Best Practices at LBNL

The Department of Energy and LBNL have an opportunity to gain significant improvements in mission performance and cost-effectiveness through instituting the best practices described here. We propose that BSO and LBNL test the recommendations in this study. The BSO/LBNL effort could also serve the broader LOB Working Group study as a test bed for additional FFRDC improvement concepts arising from later studies.

The testing would take place over several years and include all of the elements described here, beginning with a new contract between the University of California and DOE for operating LBNL. The contract would specify the terms and conditions of the BSO/LBNL testing activity, including planning, implementation, and evaluation phases. As part of the test, we would put in place a set of measures that would quantify improvements in mission performance and increases in cost-effectiveness and efficiency. In addition, we would track and catalog lessons learned as this new approach evolves. These lessons would provide valuable guidance for LBNL and for other DOE laboratories as well. Annual progress reports summarizing this information would be provided.

Report Overview

In the remainder of this report, we summarize the A&O environment and the best practices at NCAR, JPL, and LBNL in seven areas of inquiry:

- laboratory contract management
- implementation of operations and administrative directives
- business and personnel systems and policy
- counterintelligence and security
- environmental health and safety
- facilities and infrastructure
- construction project management

Summary of Current and Recommended Practices

As an aid to evaluating the information presented in the following chapters, we have summarized the key characteristics of the current practices at JPL, NCAR, and LBNL (see Table 3) and listed the corresponding best-practices recommendations for DOE and LBNL adoption.

Table 3. Summary of Current Practices and Recommendations.

Management Area	JPL	NCAR	LBNL	Recommendations
Laboratory Contract Management **(See Pages 29–34)**	JPL is the only FFRDC contractor for NASA; therefore, the contract terms are unique to JPL conditions and mission needs. An onsite NASA Management Office is responsible for managing the contract. The JPL contract includes task orders for all major R&D activities. Consequently, the NASA Management Office is responsible for mission success as well as A&O activities. This single contact creates an operating environment with clear lines of authority and accountability between the federal agency and the contactor. A&O requirements are clauses in the contract.	NCAR is one of five FFRDCs sponsored by NSF through cooperative agreements. It is administered through NSF's geoscience line management involving four NSF Headquarters employees. There are no federal employees at NCAR or in the vicinity. The NSF Program Manager is responsible for oversight of the cooperative agreement with a single point of contact at NSF Headquarters.	LBNL is a DOE FFRDC national laboratory whose contract is evaluated every 5 years through an "extend/compete" process. For 2002, LBNL's contract will be negotiated separately from the UC-NNSA Labs. Since 1992, the UC–DOE contracts have been "Performance Based." However, the practice of contractually referencing A&O directives through appendices adds additional A&O work processes beyond those that improve performance. These directives are incorporated in "Appendix G" by the contracting officer (DOE OAK). Program guidance comes from DOE Headquarters, and A&O work is primarily overseen by field units.	• Single federal official for oversight • Federal requirements and national standards • National experts for A&O assurance reviews • Flexibility in implementation of directives • Systems-based performance and validation oversight • Strengthening contractor accountability and incentives • Implementation of a Best Practices test project
Implementation of Operations and Administrative Directives **(See Pages 35–41)**	NASA promulgates directives termed "NASA Issuances," per contract Clause G-14, which requires bilateral acceptance by both Caltech and NASA. Caltech must make a good-faith determination on the appropriateness of the issuances. A contract clause states, "The set of contractually binding NASA Issuances shall be revised through bilateral modifications to the Contract."	NSF does not have a directives system for contractor A&O requirements. NSF uses OMB policies through the NSF-UCAR contract. NCAR employs nationally recognized business practices.	DOE has an extensive Directives system that generates A&O requirements. In the late 1990s, the Field Management Council, composed of representatives from the DOE executive offices, program line organizations, and other policy and field offices, became the focal point for a directives review process. The FMC process provides an opportunity for programmatic and laboratory compliance concerns to be raised before formal approval of new requirements. At LBNL, for some directives (for example those in ES&H), DOE and LBNL have developed a WSS process that limits the applicability of non-value-added directives.	• Bilateral evaluation and implementation of directives • "Work Smart Standards" approach to all A&O mandates • Field Management Council strengthened for executive oversight

Table 3. Summary of Current Practices and Recommendations, continued.

Management Area	JPL	NCAR	LBNL	Recommendations
Business and Personnel Systems and Policy **(See Pages 42–48)**	JPL receives funding through the NASA contract with Caltech. JPL has specified business systems guidance and has multiple audit and review activities. However, JPL has as part of its prime contract a defined inventory of required reports and minimal ad-hoc reporting. JPL has resident NASA Inspector General staff and is held accountable by NASA management through the agreed inventory of reports.	NCAR is funded through the UCAR cooperative agreement. NCAR and NSF have partnered to minimize administrative costs for quality services and controls. Accountability is coordinated through a single point of contact in the program office at NSF. NCAR operates under general NSF guidelines established through OMB Circulars. Reporting requirements are defined in the contract. There have been no requests to NCAR for ad hoc reports in a number of years.	LBNL receives funding through the DOE contract. Business guidance comes from a combination of DOE documents, including the prime contract; DOE Acquisition Regulations; and DOE Directives, Notices, Standards and Manuals. DOE reviews monthly costs, approves final indirect cost rates, and is involved in personnel systems and transactions. However, there are no clearly defined standards or processes for establishing the purpose of the layers of audit and reviews conducted under the contract. Procurement practices follow DOE rules and regulations. Regular DOE reporting is supplemented by ad hoc reporting as DOE staff might require.	• Follow administrative guidance from OMB circulars instead of agency directives • Manage indirect costs with fixed rates and efficient stewardship • Report to DOE according to a reports inventory defined by the contract • Adopt the "Single Audit Act" concept • Authorize laboratory procurement under OMB Circular A-110 guidance • Elevate DOE management oversight of the personnel system.
Counterintelligence and Security **(See Pages 49–53)**	Five NASA security directives are in the JPL contract. A minimal amount of JPL work is classified. There is one NASA security staff person at JPL. Inspector General audits are conducted. JPL has a counterintelligence officer with dual reporting to JPL and NASA Headquarters. For classified work, NASA follows the National Industrial Security Program Operating Manual.	No classified work is done at NCAR. Facilities have public access and no fences. NCAR has no counterintelligence program. NSF has no security directives or specific oversight. Security is included in the NCAR/NSF contract agreement. NCAR follows standard industrial security practices and applicable laws.	LBNL security operates under approximately 50 DOE orders, policies, and guidelines, and there are 14 orders in the contract. LBNL conducts no classified work. Cybersecurity measures are based on a cost-benefit model developed by LBNL. LBNL has developed an ISSM program. Counterintelligence support (for cleared staff from other organizations) is provided by agreement with LLNL. DOE oversees and reviews LBNL's program.	• Use of national and industry security standards • Local control and direction for security programs • Independent risk and vulnerability studies • Use of cost-benefit analyses • Integrated safeguards and security management

Table 3. Summary of Current Practices and Recommendations, continued.

Management Area	JPL	NCAR	LBNL	Recommendations
Environmental Health and Safety **(See Pages 54–59)**	One NSA staff member monitors EH&S performance and external regulatory oversight. NASA has no role in regulating JPL activities. JPL conducts triennial EH&S reviews. The JPL EH&S program is designed to external agency standards. There are few NASA-unique EH&S standards in JPL's contract.	NCAR is only subject to external ES&H regulation, and NSF relies on external inspection results. NSF conducts an EH&S review every five years with the contractor renewal cycle. There is no NSF presence on site. NCAR has an EH&S self-assessment program.	LBNL is subject to many DOE ES&H directives as well as external regulations and inspections by federal, state, and local regulators. DOE has six onsite staff conducting continuous ES&H oversight plus additional Oakland staff. Some oversight is also conducted by DOE Headquarters. Five DOE offices are involved. A WSS process has reduced the number of DOE-unique EH&S standards, but some remain.	• Use certified systems methods for agency oversight and laboratory accountability • Follow a bilateral adoption process to reduce DOE-unique requirements • Adopt recognized external standards for EH&S programs whenever possible • Continue and advance use of ISM principles and performance-based management self-assessment methods
Facilities and Infrastructure **(See Pages 60–64)**	NASA manages JPL infrastructure as a single program facility. Projects over $500 K are funded from a NASA facilities construction budget. Infrastructure costs may compete for program funds.	Capital improvements are funded by special appropriations from the NSF or debt financed through municipal bonds. Recently, most improvements are from bonds.	Landlord funding is a small proportion of LBNL funding, and infrastructure often competes with program resources. Funding levels have been fixed at a small proportion of needs.	• Support for modernization and infrastructure resources must be a "landlord" priority • Use contract performance metrics for infrastructure maintenance • Use incentive contracts for outsourced maintenance
Construction Project Management **(See Pages 65–68)**	JPL coordinates with a single point of contact at NASA headquarters. This individual visits the JPL facility quarterly to review and inspect projects.	NSF-funded work is reviewed quarterly, and there is a direct line of communication between the facilities department and the responsible NSF Headquarters individual.	The DOE/SC Construction Support Division benefits planning and design. A local federal project manager oversees projects and conducts reviews. Reviews are also conducted by Engineering Construction Management in DOE's CFO.	• Streamline construction project management • Follow standard regional and industry practices

Laboratory Contract Management

Contract administration was reviewed at NCAR, JPL, and LBNL. The review focused on two primary areas:

- expectations of the sponsoring federal agency with an understanding of how those expectations are communicated to the laboratory
- laboratory operator accountability for performance of scientific work and related laboratory administration and operations

The NCAR and JPL laboratories provide a sound basis for comparisons to and contrasts with LBNL in approaches to contract administration. Like LBNL, both are FFRDCs, and all three laboratories are subject to the general policy guidance for agreements to operate FFRDCs found in Federal Acquisition Regulation (FAR) Part 35, *Acquisition of Research & Development*. Both NCAR and JPL operate under agreements issued by federal agencies—NSF and NASA—having specific enabling statutes that include authorization to do research by contract or other agreement.

NCAR

The National Center for Atmospheric Research is operated under a cooperative agreement between NSF and UCAR, a nonprofit corporation created for research and educational purposes by 66 member institutions that grant doctorates in atmospheric sciences. The agreement format was adopted within the past decade, after many years of operating under a management and operating contract. The cooperative agreement establishes a basic framework for management of NCAR, with Scientific Program Orders (SPOs) providing discrete direction on scientific effort. The agreement relies heavily on national standards for the care and treatment of federal funds and other resources. In turn, the agreement provides minimal guidance to the contractor in meeting the standards.

In both its reputation and its opportunity to receive new SPOs, NCAR is held accountable for its scientific performance. A single program official at NSF is designated as responsible for all actions under the agreement. Performance assessments of NCAR activities are performed periodically by a variety of NSF offices and external experts in the areas assessed. The results are then furnished to the NSF program office.

JPL

The Jet Propulsion Laboratory is operated under a FAR-based cost-plus-award-fee arrangement between NASA and the California Institute of Technology (Caltech). The operating agreement establishes a basic arrangement for the conduct of research and engineering and those supporting activities involved in managing the laboratory. Specific research and engineering projects are defined in a series of NASA Task Orders. Requirements for supporting activities are derived from the contract terms, including specified NASA Issuances made applicable to the contract through negotiation.

Like NCAR, JPL is held accountable for its scientific and engineering performance in its reputation and its opportunity to receive new tasks. Caltech is held accountable for its management of JPL in a manner consistent with other FAR-based contracts: (1) costs to be reimbursed must be reasonable, allocable, and incurred in accordance with the terms of the contract; (2) performance levels in award-fee areas result in the specified fees; and (3) performance can be a factor in termination or extension of the contract.

Program managers at NASA work closely with JPL project personnel in the conduct of research and engineering task orders. In addition, NASA uses its local management office to provide contract administration, laboratory oversight, and program coordination.

The annual award fee plan and fee determination by NASA constitute the single overarching assessment of JPL. The plan is weighted 65% for programmatic performance, 25% for its institutional management performance and operations, and 10% for its support to outreach programs. The fees awarded have been fairly stable. Caltech fees go into the general budget, which covers a wide range of institutional activities and also pays for unreimbursed operating costs at the laboratory.

LBNL

Lawrence Berkeley National Laboratory is operated under a management and operating contract between DOE and the University of California (UC). The operating contract establishes a basic arrangement for the conduct of research and technical efforts and those supporting activities involved in managing the laboratory. Specific research projects are defined in a series of work authorizations issued by DOE program officials. Requirements for supporting activities are derived from the contract's terms, including specified DOE policies and directives made applicable to the laboratory's operations by DOE. The DOE directives are issued by a variety of administrative and operational organizations within DOE Headquarters with varying levels of coordination and review.

The laboratory is held accountable for its scientific and technical performance, both in its reputation and in its opportunity to receive new research. The University of California is held accountable for its management of LBNL in a manner consistent with other FAR-based management and operating contractors. Department of Energy program managers and other research sponsors work closely with LBNL scientific and technical personnel in the planning, conduct, and reporting of research work. The DOE's local office, the BSO, interfaces with the Office of Science on a variety of administrative, operational, and program issues.

The LBNL contract includes a comprehensive annual performance-based management assessment and appraisal. The A&O appraisal part of this contract is an elaborate and labor-intensive process using a large number of detailed, quantitative performance metrics and requiring extensive involvement from LBNL, UC, and DOE staff. In addition, LBNL conducts a self-assessment that is validated by UC and DOE. DOE makes the final determination on performance achievement. The resultant appraisal rating from DOE is weighted 50% for scientific and technical achievement and 50% for administration, management, and operations. A performance fee of up to $1.6 million is paid in amounts specified by the contract and is used to offset any operating costs not reimbursed to UC and to provide funding for university-based research.

Best Practices and Recommended Actions

Single Federal Official for Oversight. A single federal office should be responsible for mission success and A&O oversight. Oversight of A&O activities should be integrated under a federal program management office to ensure that mission prioritization is done properly. The National Science Foundation and NCAR have effectively done this as a best practice. The National Aeronautics and Space Administration and JPL have a similar, though perhaps not as rigorous, focused approach embodied in JPL's onsite NASA Management Office. The LBNL contract should also clearly describe roles and responsibilities, performance expectations, and behaviors for all parties involved in the contractual agreement. Both NCAR and JPL have incorporated these best practices into their contracts to one degree or another.

Recommended Action: The contract should reflect line management operational accountability from the Director of the Office of Science through the Berkeley Site Office to LBNL. The roles and responsibilities of the DOE Headquarters personnel, BSO staff, UC officers, and LBNL employees should be clearly described. Performance expectations that integrate accountability for both mission performance and A&O activities should be specified. The behaviors expected of all parties should also be clearly defined.

Federal Requirements and National Standards. Stimulating innovation and encouraging development of best practices are only possible when the contractor has the latitude to develop administrative processes and procedures that are efficient and effective. Prescriptive requirements that describe not only what, but how administrative and operational actions are conducted leave little room for innovation. The contract and the relationship between LBNL and DOE result in many such prescriptive requirements. On the other hand, NCAR has been able to operate in a cost-effective manner because it is managed under a set of rules that specify general administrative requirements for federal nonprofit contractors (see "Business and Personnel Systems"). Similar benefits have been obtained at JPL in Environmental Health and Safety areas, because JPL staff work to OSHA, FAA, and EPA standards (see "Environmental Health and Safety").

Recommended Action: DOE should initiate a project, using a new LBNL contract as a model, to test the use and benefits of general federal requirements for A&O activities at the laboratory. Specific recommendations for adopting appropriate federal requirements and national standards are provided in the chapters on business and personnel systems, EH&S, security, and construction management. The contract should also provide general guidance on using federal requirements and national standards wherever possible.

National Experts for A&O Reviews. Monitor the quality, compliance, and performance levels of A&O systems through an appropriate and complementary combination of expert reviews, internal audits, and performance-based management tools. The NSF's reliance on a single annual audit of NCAR's finances by a nationally recognized accounting firm is a credible, cost-effective, and reliable means of assuring stewardship of federal resources. In addition, NCAR uses nationally recognized safety and security experts for workplace hazards analysis and risk assessment.

Recommended Action: The DOE should adopt NSF's approach of using a single annual audit of laboratory finances to assure stewardship of government funds. This annual external audit should be augmented by appropriate and complementary use of audits internal to UC/LBNL and by the use of performance-based management tools for contractor oversight. The contract should also provide general guidance on using national experts for reviews wherever possible.

Flexibility in Implementation of Directives. Department of Energy policies should guide contractor work. Directives from DOE should not be unilaterally applicable to contractors and should not require prescriptive compliance. Business and regulatory standards, norms, and principles should govern administrative and operational objectives. The laboratory should be allowed to exercise discretion in the manner in which work is actually performed. The National Center for Atmospheric Research has effectively achieved this level of direct management accountability. The Jet Propulsion Laboratory has succeeded to a lesser extent through bilateral negotiations with NASA in the implementation of special requirements.

Recommended Action: The contract should provide for LBNL's adoption of federal standards and good management principles to guide administration and operation. The contract should provide for a transition from the current prescriptive policies and work directives to an environment where policy guidance is implemented appropriate to site-specific conditions.

Systems-based Performance Measurement. Use of nationally standardized system requirements and practices for A&O work improves the levels of assurance and credibility in laboratory stewardship of resources and systems. Stewardship efforts employing standard systems can be significantly enhanced through audits, reviews, and evaluations conducted at the systems level. Moreover, the contractor's accountability for implementation and performance is assessed at the systems level. Systems performance appraisals may use self-assessment programs or comprehensive systems-based reviews or both. Such systems-based metrics can be effectively benchmarked against best industry practices and national metrics for best-in-class systems.

Recommended Action: DOE and LBNL should change the performance-based management system under the current contract to one using systems-based benchmarks, metrics, and measurement trends for verifying certified systems and for overseeing performance.

Contractor Incentive Systems. Contractor incentives should be designed with mission interests foremost. Laboratory appraisals should be weighted according to the work's value; DOE ratings for science laboratories should be predominantly weighted by scientific accomplishments and research performance. Laboratory contractors should be held accountable to high public standards but should be rewarded for excellence in management and A&O performance with the opportunity to continue to operate the laboratory in the public service. Only DOE maintains that, even with the highest performance in managing an FFRDC, the contract for operation might become subject to competition.

Recommended Action: It is recommended that DOE change the weighting in LBNL's performance rating scheme to place greater emphasis on the science by increasing the program work weighting to between 65% and 75%. Moreover, DOE should consider the practice of routinely adding one year to existing LBNL contract terms for each year with "outstanding" overall laboratory performance (up to a maximum of five extensions, or ten years total). DOE should also consider the loss of a year from the contract's term for unsatisfactory performance. Such an incentive/dis-incentive approach would provide many benefits for laboratory science programs, DOE administrative and program offices, and contractor management. In keeping with the philosophy of greater line accountability (see Figure 5), the decision on LBNL's annual performance appraisal rating should come from the Secretary of Energy's Office, along with an "incentive/dis-incentive" notification to the Laboratory Director.

Implementation of a Best Practices Testing Project. The DOE and LBNL have an opportunity to gain significant improvements in mission performance and cost-effectiveness through instituting the best practices described here. We propose that BSO and LBNL test the recommendations in this study. The BSO/LBNL effort could also serve the broader LOB Working Group study as a test bed for additional improvement concepts arising from other studies.

Recommended Action: We recommend that a test and evaluation project take place to access the best practices described here, using as a test vehicle a new contract between the University of California and DOE for operating LBNL. The contract would specify the terms and conditions of the effort, including planning, implementation, and evaluation phases. Because of the sweeping scope of the changes recommended here, a carefully laid plan is essential for the transition from the current requirements, work practices, and relationships to a new way of working together. The planning phase must include close cooperation between senior leadership of DOE, the Office of Science, the BSO, UCOP, and LBNL.

As part of the test project, we would put in place a set of measures that would quantify the improvement in mission performance and the increases in cost-effectiveness and efficiency at LBNL, DOE, and UC. In addition, we would track and catalogue lessons learned as the transition to this new approach evolves. Those lessons would provide valuable guidance not only for the success of this project, but for other DOE laboratories as well. Annual progress reports summarizing the status and benefits would be provided.

The first step in this proposed project would be to develop a new contract for LBNL. The timing for this preparatory work is excellent because it coincides with the expiration of the current five-year contract between DOE and UC/LBNL on September 30, 2002. The next step would be to formulate all plans, protocols, and procedures to launch the project on October 1, 2002. At the beginning of the project, a project baseline would be developed that documents current policies, work processes, and costs. This would provide a clear way of tracking changes and documenting the benefits of implementing these best practices. The last year of the pilot project would include a formal evaluation of the benefits and drawbacks of the new administrative and operating practices. Annually, BSO and LBNL would report on the evaluated benefits and drawbacks to the best practices as implemented at Berkeley Lab.

“Because of the sweeping scope of the changes recommended here, a carefully laid plan is essential for the transition from the current requirements, work practices and relationships to a new way of working together.”

Implementation of Operations and Administrative Directives

This chapter reviews the type, content, and extent of directives and A&O work requirements issued to each laboratory by its sponsoring federal agency. This inquiry assessed how laboratory A&O policies and procedures are developed to reflect federal criteria, and the corresponding impact on or value to the laboratory of complying with them. Specific inquiries included

- determining what drivers initiate new agency policies, what systems are used for implementation, what roles program line managers have in influencing the impact of changing A&O requirements, and what responsibility the contractor has in policy implementation and compliance;
- identifying approaches for customizing policies to specific site characteristics, for employing "graded approach" methodologies, or for adopting other A&O work criteria in place of federal requirements;
- assessing what contractual mechanisms exist and how they are applied to agency A&O requirements for laboratory management;
- identifying processes for monitoring federal policy promulgation and for managing laboratory policy adaptation, implementation, and compliance.

From this information, we determined what practices might provide the most cost-efficient and compliance-effective implementation of federal sponsor A&O expectations and requirements.

NCAR

The National Science Foundation does not have an established promulgation system for contractor A&O work requirements or mandatory contractor processes and policies. Those necessary NSF and federal (e.g., Office of Management and Budget) policies and work directives take effect through the main NSF–UCAR contractual agreement. Through NSF-sponsored advisory committees and program workshops, NCAR gains early knowledge of the impacts from emerging NSF program directions and has the opportunity to provide feedback. For administrative and operational criteria, NCAR adopts nationally recognized business practices and professional standards.

JPL

Policy direction of JPL by NASA is in the form of clauses within the NASA–Caltech prime contract and in NASA Issuances, as recognized by JPL's contract (Clause G-14). JPL's contract language regarding NASA Issuances is cited here. Several very important clauses that will be discussed further are shown in boldface.

G-14 NASA Issuance System

(a) **The parties hereto agree that NASA Management Directives System publications ("NASA Issuances") are not in and of themselves applicable to the Contractor, and that the Contractor therefore is not obligated merely by virtue of their issuance to implement their intent or to observe the policies and procedures set forth therein, irrespective of the fact that certain NASA Issuances may state that they apply to JPL. NASA Issuances become contractually binding and obligatory upon the Contractor only when and to the extent made so by appropriate contractual means.**

(b) The parties hereto further agree that certain NASA Issuances referenced in this contract have been made contractually binding and obligatory upon the Contractor. NASA Issuances accepted by the Contractor may be subject to certain conditions and limitations specified in the contract.

(c) In order to provide a bibliography of NASA Issuances in the categories identified in paragraph (b) above, the parties agree to maintain Appendix C to this contract which shall list all NASA Issuances referenced in this contract.

(d) In order to maintain Appendix C in a current condition, it is agreed that the Contractor will issue, periodically for Contracting Officer approval, an up-to-date Appendix C, which shall list all NASA Issuances referenced in the contract contractually binding and obligatory upon the Contractor.

(e)(1) During the period of this contract, NASA anticipates that new NASA Issuances will be released, that current NASA Issuances may be revised, and that the Agency may consider some of the aforementioned newly-released or revised Issuances to be appropriate for incorporation into this contract. **The Contractor therefore agrees to support the timely and orderly generation, review, and disposition of new or revised NASA Issuances as set forth below.**

(2) Should NASA request the Contractor's input during formulation or revision of NASA Issuances, the Contractor shall ensure that its representatives in this regard provide support and advice to NASA regarding the content of NASA Issuances from the standpoint of cross-agency functional and technical suitability. Should the Contracting Officer specifically

request that such input address the applicability of the Issuance's content to work to be performed under this contract, the Contractor will provide such input, but the parties recognize that (i) the Contractor's input will require additional time due to the need to engage all affected JPL organizations, and (ii) the Issuance shall be binding only as provided in paragraph (4) below.

(3) When the Contracting Officer requests the Contractor to consider a particular Issuance or revision for contractual incorporation, **the Contractor shall make a good-faith determination of whether and to what extent such incorporation would be appropriate.** Where full acceptance is not considered appropriate, the Contractor shall promptly provide a written explanation to the Contracting Officer, including, when applicable, any specific proposed conditions or exceptions to the content of the Issuance.

(4) **The set of contractually binding NASA Issuances shall be revised through bilateral modifications to the Contract.**

The managements of JPL and NASA work together to decide which issuances are applicable to the laboratory, how an issuance should be appropriately implemented, and to what extent site-specific A&O work must comply with issuance requirements. The resulting agreement is documented in bilateral contract actions. This process occurs on a large scale during the negotiation of their five-year contract agreement, which includes a top-to-bottom review and consideration of NASA Issuances. At other times, the NASA–JPL process for issuance acceptance appears similar to the DOE–LBNL Work Smart Standards procedure. This method appears to work well for both NASA and Caltech.

LBNL

The DOE Office of Science is both LBNL's primary research sponsor and its institutional steward. The DOE/NNSA Oakland Operations Office holds the prime contract with the University of California for management and operation of LBNL. The DOE Berkeley Site Office is a 16-person office on site at LBNL; BSO reports to DOE/SC but interacts closely with OAK in the administration of the LBNL contract, including program-execution support and operational oversight.

For LBNL's contractual A&O work requirements, OAK is responsible for developing the terms and conditions based on federal and agency requirements, experience, and specific circumstances that warrant deviations from "DOE standard" contract terms. The DOE-postulated collection of A&O requirements is derived from federal statutes and augmented by DOE directives. The DOE–UC contract covering LBNL dates back to 1947, and the current practice of contractually citing A&O work requirements is a recent evolution. Every five years, an "extend/compete"

process takes place and effectively redesigns and renegotiates a new FFRDC contract with UC. It includes new A&O work requirements in the form of added contract clauses and additional directives.

Laboratory A&O work requirements are drawn primarily from federal statutes and DOE policies as contained in DOE Orders, Notices, Standards, Guides, and other directive documents. As DOE is self-regulated in terms of safety requirements and some environmental issues related to radiation, many of the LBNL A&O requirements are in the area of EH&S. Changes ensue when external circumstances cause alterations in existing DOE policies and practices. Requirements are sometimes added in response to issues that arise at other DOE sites, such as many recent DOE directives related to weapons security, large-value project management, and nuclear-facility quality assurance. Besides the rigorous contract renewal cited above, DOE directives and other work criteria are periodically added to laboratory A&O requirements (see several examples cited later) through procedures accompanying DOE Contract Clause No. 5.5, an important portion of which follows:

Clause 5.5–DEAR 970.5204-78. Laws, Regulations, and DOE Directives

(a) In performing work under this contract, the Contractor shall comply with the requirements of applicable federal, state, and local laws and regulations, unless relief has been granted in writing by the appropriate regulatory agency.

(b) **In performing work under this contract, the Contractor shall comply with the requirements of those DOE Directives, or parts thereof, identified in the List of Applicable Directives (List) referred to in Appendix G, DOE Directives. The Contracting Officer may, from time to time and at any time, revise the List by unilateral modification to the contract to add, modify, or delete specific requirements;** provided, however, that no directive added to the List shall in any manner modify the rights and obligations of the Parties except as set forth elsewhere in this contract.

(c) Prior to revising the List, the Contracting Officer shall notify the Contractor, in writing, of DOE's intent to revise the List and provide the Contractor with the opportunity to:

(1) Assess the effect of the Contractor's compliance with the revised List on contract cost and funding, technical performance, and implementation schedule for directives on the List; and

(2) Identify any potential inconsistencies between the revised List and the other terms and conditions of the contract, including an alternative set of requirements incorporated by reference in accordance with paragraph (f) below.

(d) Within 30 days after receipt of the Contracting Officer's notice, the

Contractor shall advise the Contracting Officer, in writing, of the potential impact of the Contractor's compliance with the revised List, including the matters identified in paragraph (c) above.

(e) Based on the information provided by the Contractor and any other information available, the Contracting Officer shall decide whether to revise the List, and so advise the Contractor not later than 30 days prior to the effective date of the revision of the List. The Contractor and the Contracting Officer shall identify and, if appropriate, agree to any changes to other contract terms and conditions, including cost and schedule, associated with the revision of the List pursuant to Clause 5.6, Changes. No DOE directive shall be considered a requirement of this contract unless it has been included in the List in accordance with the procedures set out in this clause.

The system of DOE directives is the primary means of codifying agency policies and requirements through an agency-wide process composed of several overarching development and deployment steps. The applicability of a directive is considered in developing the set of directives to include in the laboratory's contract (see Appendix G of the LBNL contract). Requirements for EH&S can be adopted through a Work Smart Standards (WSS) process that forms a special subset to Appendix G.

Since DOE accomplishes almost all of its mission work through contractors, it does not make significant federal-versus-contractor distinctions. In addition, most DOE policies are developed with broad and uniform application to federal staff, agency offices, contractors, and laboratories. For those DOE directives that have both a federal and laboratory contractor component to them, the contractor part is stipulated in an attached Contractor Requirements Document. In practice, however, some DOE (and some laboratory) staff often interpret and enforce the full spectrum of a directive as applying to a laboratory regardless of words to the contrary.

To help prevent such misinterpreted or misapplied directives, in the late 1990s DOE developed an important addition to the work of the Field Management Council (FMC). The FMC is composed of representatives from the DOE executive offices, key program line organizations in DOE, and other DOE program, policy, and field offices. Through the FMC meet-and-confer process, all entities within DOE (via the established line-management structure) are afforded opportunities to comment on new or revised directives before they are drafted and again before national promulgation for field implementation. Comments voiced and issues raised are brought to the FMC forum by senior line management. The relatively new FMC process provides an opportunity for programmatic and laboratory compliance concerns to be raised before formal approval of new A&O requirements.

Moreover, in cases of line-management partnering between laboratory and local DOE representatives, some level of site discretion in implementing and mandating rigorous A&O requirements may be possible. For EH&S requirements, the WSS

process is a good example of site-specific tailoring of requirements through bilateral line-management partnering. With WSS, A&O directive requirements are reviewed jointly by LBNL, OAK, and BSO through a fully developed and documented protocol, and a tailored approach to implementation is developed and mutually agreed to. Administrative requirements in the areas of finance, procurement, property, and personnel generally do not have a mechanism that allows for customization to site needs or a graded approach.

With the introduction of performance-based contracting in 1993, many DOE A&O audits and reviews were collapsed into a single integrated annual appraisal built on laboratory self-assessment. In addition, the implementation of many DOE A&O requirements is incentivized in concept through the A&O contract performance measures (currently including about 85 topic measures and approximately 175 individual metrics).

Best Practices and Recommended Actions

Bilateral Evaluation and Implementation of Directives. Clear contract language on the A&O work requirements process, clarification of the limits of applicability of each agency A&O work criterion, and well-defined laboratory exemptions to specific sections of policy mandates are noteworthy laboratory practices. The language in the NASA–Caltech contract for JPL provides a best practice for clear, direct guidance to both laboratory managers and regulatory overseers on the applicability as well as the extent and intent of compliance for individual NASA A&O work requirement documents.

Recommendation: DOE and UC should adopt language used in the NASA–Caltech contract for JPL to replace the Appendix G contract language regarding DOE directives. In addition, DOE should consider such "best practice" contract directive improvements for all FFRDCs.

Work Smart Standards for all A&O Activities. The LBNL partnership and contract administration protocols in effect for the WSS process offer a foundation for an outstanding approach to site-specific, mission-focused selection and tailoring of work requirements by a bilateral line-management team. At present, the EH&S work standards and DOE's directives are reviewed jointly with a common eye toward the best criteria for laboratory compliance in view of the laboratory's mission work and other program criteria. By emphasizing mission results and stronger leadership by federal and laboratory line management, the WSS model can become a best practice for broader application.

Recommendation: DOE, working with line leadership, should develop a next-generation "A&O Work Smart Standards" contractor requirements methodology. It should bring a balanced mission focus to the process and adopt the methodology for all remaining administrative, managerial, and operations work areas.

Field Management Council. The FMC provides program line-management involvement and governing council approval for review, discussion, vetting, and endorsement of policy mandates and work directives by all affected and interested parties in the DOE community. This is a best management practice for scientific mission direction. With this approach, directives (usually originating from DOE operations, administrative, legal, and policy offices) designed for a narrow DOE sector can be kept from having wide negative community impact by obtaining program concurrence on applicability to facilities under their cognizance. Directive requirements that may have unintended negative mission effects can thus be vetted by a group with broad expertise and experience. Policies designed by specialists with senior line-management input and approval show improved quality, implementation, and field acceptance and quicker compliance.

Recommendation: DOE should sustain the FMC method of rigorous, disciplined involvement of line management in oversight of A&O policies and processes, require program concurrence on applicability to specific facilities, and consider expanding the use of line-management forums such as the FMC.

Business and Personnel Systems and Policy

Business and personnel systems and policy were examined at the three organizations (NCAR, JPL, and LBNL) to determine the factors that influence the cost, effectiveness, and efficiency of various business processes. Specific activities that comprise the processes were analyzed to identify selected best practices for potential research laboratory implementation.

Historically, the government has used two different approaches in the pursuit of research services: procured services and acquired services. When research services were procured, the government "owned" the research entity. When research services were acquired to carry out a general public purpose, strong long-term federal–contractor relationships were usually formed. Government procedures and directives encumber these "acquired" relationships less. Over the years, the lines between these two approaches have become blurred. Consequently, the differences in administrative structure and operations have been homogenized to the point that contractor identity, responsibility, accountability, and value have diminished.

The procured entity has been viewed as an extension of the "owning" agency. Therefore, the procured research organization has been subject to agency directives and additional general governmental rules and standards. The procured organizations have developed a set of administrative requirements with funding agencies that are complex and expensive. Program funding is spent on layers of administrative operations in an attempt to ensure zero risk. Each of the best practices identified in this chapter requires the reestablishment of distinct roles and responsibilities for the contractor and the agency.

The following is an overview of the three laboratories' business and personnel operations.

NCAR

The National Center for Atmospheric Research receives the majority of its funding through a cooperative agreement with NSF. The two have established a cooperative working partnership in order to maximize funding available to the scientific mission by maintaining the minimum levels of administrative operations necessary for quality administrative services and appropriate internal controls. By operating as a provider of acquired research services, NCAR is able to achieve a high level of efficiency and effectiveness with a minimum of unnecessary activities. Management accountability is coordinated through a single point of contact in the NSF Program Office. The laboratory receives financial and administrative services via approximately 145 staff members in UCAR's Finance and Administration Office.

The laboratory operates under general NSF guidelines and the principles for administrative operations established through the Office of Management and Budget (OMB) circulars. Reporting requirements are defined in the cooperative agreement. Requests for ad hoc reports are generally programmatic in nature and are handled by the NCAR staff. Indirect costs are calculated by using negotiated fixed rates with provisions for managing variances in future rate calculations.

Audit requirements are satisfied by acceptance of the Single Audit concept. A professional certified public accounting (CPA) firm performs an annual, comprehensive audit of financial activities and related operational actions. This audit assures various stakeholders that there are adequate systems of administrative and internal controls to minimize risk.

Human resources are delivered by a staff of thirteen professionals (12.3 FTEs), supplemented by generalists who work in the scientific departments. Similarly, financial services are delivered by a small staff of accounting professionals (seven project accountants), supplemented by generalists who work in the scientific divisions. The University Corporation for Atmospheric Research has approximately 145 administrative employees, comprising approximately 10% of NCAR's workforce. At LBNL, administrative employees are almost 25% of the employee population.

Policies are not mandated by NSF, and the cooperative agreement requires only policies associated with human resources, intellectual property, and technology transfer. Financial policies are not reviewed by NSF. The laboratory has developed its own policies and procedures adhering to various OMB circulars, coupled with generally accepted professional standards and principles.

JPL

The Jet Propulsion Laboratory receives the majority of its funding through a prime contract with NASA. Through focused contract management strategies, JPL has been successful in clearly defining sources of guidance. As a contractor, JPL has most of the constraints and multiple audit activities that are present at LBNL. There is one clear and important exception to this in the area of reporting. As part of its prime contract, JPL has successfully negotiated a defined inventory of required reports. The laboratory has been successful in minimizing ad hoc reporting. It has resident NASA Inspector General staff and is held accountable by NASA management through the agreed inventory of reports.

LBNL

Lawrence Berkeley National Laboratory receives the majority of its funding through its prime contract with the DOE. At LBNL, performance-of-work guidelines come from a combination of DOE documents, including the prime contract; Department of Energy Acquisition Regulations; and Department of Energy Directives, Notices, Standards, and Manuals.

In the Financial Services Department, including the Sponsored Projects and Procurement offices, LBNL has 74 FTEs. There are approximately 65 FTEs in the Human Resources Department. The Financial Services Department works with divisional analysts to deliver financial services to the scientific divisions. At peak times of the year, such as year-end close, there are 8 to 14 divisional field analysts engaged in the delivery of financial services. The Human Resources Department has a core staff of 16 professionals, with an additional 49 staff members deployed to human resource service centers to provide divisional field support.

Indirect costs for LBNL are calculated to support the administrative budget through a system of provisional rates adjusted to funding-agency-approved, year-end indirect costs. The external DOE audit and inspection practices for LBNL are conducted under the contract. However, there is no clearly defined standard or process for establishing the purpose of a multilayered audit, which is encouraged by this contract.

The laboratory's procurement practices are established in a DOE-approved system, which follows DOE rules and regulations. Day-to-day operations are managed through a system of DOE-required reports, supplemented by ad hoc reports, such as those the contracting officer might require.

Best Practices and Recommended Actions

Follow Administrative Guidance from OMB Circulars Instead of Agency Directives. The administrative complexities of DOE organizations are so layered and complex that redundancies create confusion and make the establishment of meaningful administrative controls difficult. Transactional administrative activities are continuously monitored by DOE offices for proof of performance. In contrast, organizations that provide research assistance services operate under a more general oversight, with guidance flowing down from various OMB circulars and an inventory of selected and agreed-to sections of the Federal Acquisition Regulation. In this case, professional standards and principles are followed in order to maintain accountability for public funds. For example, in accounting, in place of DOE's federal agency directive (e.g., the DOE Accounting Handbook) a contractor in an acquired services organization would be subject to Generally Accepted Accounting Principles (GAAP), Governmental Accounting Standards Board (GASB) rules, Cost Accounting Standards (CAS), OMB circulars, etc. Cost,

quality, and accountability would be used to measure performance, with a primary focus on programmatic performance.

The National Center for Atmospheric Research achieves a high level of business and personnel efficiency and support service effectiveness with a minimum of unnecessary or non-value-added administrative processes. This trust-based relationship with the establishment of clear and simple lines of accountability for mission support is a best practice. The center, which works with its primary funding agency, is clearly accountable for its public funds. This accountability is maintained through a single point of direct contact to the funding agency's program office. This balanced relationship allows local maintenance of an adequate system of administrative and internal controls while maintaining the organization's primary focus—its scientific mission. This best-practice approach optimizes programmatic funding. There are no separate administrative, tracking, and reporting structures requiring disproportionate support. Instead, organizational-level accountability flows down from the cooperative agreement, gains from improved performance, and flows back directly to mission programs. In this integrated scientific and administrative program, there is no administrative layering or filtering to impede performance.

Recommended Action: DOE and LBNL should adopt this approach to integrate administrative and operational requirements into the mission focus and to better establish LBNL management lines of responsibility and accountability. The laboratory should be authorized to operate under the guidance of OMB Circular A-110, *Uniform Administrative Requirements for Agreements with Other Non-Profit Organizations*; Circular A-122, *Cost Principles for Non-Profit Organizations*; and Circular A-133, *Audits of Non-Profit Organizations*.

Manage Indirect Costs with Fixed Rates and Efficient Stewardship.

LBNL operates with annually reviewed, DOE-approved provisional indirect cost rates without a variance carry-forward provision. Cost pools must be reviewed throughout the year to make certain that the approved rates will generate sufficient funding to meet the approved indirect cost budget without exceeding that budget level.

It is the position of DOE that rates and recoveries must be managed period by period. The department insists that rate adjustments be made during the year to recognize variations in projected recovery and correct projected overages or shortages as soon as they are foreseen. The changes in rates affect every principal investigator and every project at LBNL. Disproportionate costing occurs when these retroactive rate adjustments cannot be applied to a closed project. If there is a projected over-recovery, the alternative to rate reduction is to increase the approved budget to fund additional items that were not included in the original budget. The almost continuous process of rate recovery, costing, reviews, and budget adjustments is not an exact science. Both DOE and LBNL would be better served if LBNL could budget to estimated requirements, but spend to meet mission-priority

needs. There should be no penalty for being a good steward of federal research funds.

LBNL should establish adequate rates to fund the approved budget. If LBNL projects that recovered funds will exceed the funds needed for required expenditures, then it should have the ability to either reallocate funds to essential activities that previously had not been fully funded or budgeted, or apply any overage to a following period in order to reduce the latter period's indirect costs.

As a best practice, NCAR has a negotiated fixed rate with specific provisions for future applications of any "over-recovery" through the NCAR budget process. As a contracted partner in delivering services, the primary funding agency is assured that NCAR will recover or fund the applicable variance in a future rate calculation. At LBNL, the adoption of this as a best practice would promote innovative work and better stewardship of funds.

Recommended Action: LBNL should be authorized to negotiate fixed indirect cost rates with application-specific negotiated provisions for any "over-recovery."

Report to DOE According to a Reports Inventory Defined by the Contract. Both NCAR and JPL manage a defined inventory of reports established by negotiation with the funding agency and delineated by their agreements. In LBNL's contract with DOE, reporting requirements are ambiguously described: "The contractor shall furnish progress reports and schedules, financial and cost reports, and other reports concerning the work under this contract as the Contracting Officer may from time to time require." In contrast, both JPL and NCAR operations have focused and defined requirements for a set inventory of reports.

At LBNL, the Chief Financial Officer organization alone provides DOE with more than 48 separate reports. In general, reporting requirements are not well thought out. DOE tends to ask for redundant data rather than management information. Of these 48 reports, ten are ad hoc reports that have now become regular reports in case the same question that triggered the one-time-only ad hoc report is asked again. By contrast, NCAR provides NSF with three reports, as defined in its cooperative agreement.

Both NCAR and JPL have agreements to provide additional reports if there is a defined and bona fide request. Generally, the information being requested can be obtained from the agency's accounting or the contractor's reports. Requests by NSF for ad hoc reports tend to be programmatic in nature and are handled by the technical divisions. On the other hand, LBNL is bombarded with ad hoc requests. Over the last few years, LBNL has made a substantial investment in developing a management information system to better handle these requests. This investment has resulted in LBNL having better reporting tools than DOE has. When DOE receives ad hoc requests, those requests are directed to LBNL, because it is capable of responding.

The laboratory's contract provisions mandate that it provide reports to the contracting officer upon request. Laboratory financial services have designated 2.5 FTEs to coordinate responses to ad hoc requests. These coordinators then assign other LBNL employees to obtain the necessary data. Report coordinators estimate that 40% of all DOE reports are in response to ad hoc requests. These ad hoc reports interfere with, and take staff away from, operational support activities.

Recommended Action: In order to improve control and minimize waste, bureaucracy, and inefficiency, LBNL should adopt NCAR's and JPL's best practice by defining, with DOE, an inventory of required reports to be delineated in the contract. We recommend that DOE and LBNL use explicit contract language, clearly stating the intent to minimize ad hoc reporting, so as to adopt the best practice of a contract-defined report inventory. Accountability would improve through more efficient and effective use of resources.

Adopt the "Single Audit Act" Concept. The audit and inspection practices at LBNL are established by contract. The wording is prescriptive but also ambiguous. There is no clearly defined standard or process for the multilayered audits, which are encouraged by this contract. By way of contrast, NSF's cooperative agreement for NCAR implements the Single Audit Act of 1984. This act, which is codified in OMB Circular A-133, *Audits of Non-Profit Organizations*, provides risk protections and standards for obtaining consistency and fairness in the audit of nonprofits expending federal funds, and it eliminates auditing redundancy.

Lawrence Berkeley National Laboratory is subject to audit by DOE, external audit firms, and UC auditors. In addition, LBNL maintains its own internal audit staff that performs audits on behalf of DOE, UC, and LBNL management. Under the LBNL contract, DOE reserves the right to perform additional audits as deemed appropriate. For example, in FY 2001, there were 16 audits of the LBNL Financial Services Department that averaged more than 250 hours each. It is estimated that the administrative staff spent a minimum of 4,000 hours—or the equivalent of two FTEs—working on and responding to these audits. Significant labor activity and processes have been substituted for a single systematic and comprehensive annual review of administrative and internal controls. As a best practice, NCAR has a single, comprehensive financial and operational audit by a professional CPA firm as required by OMB Circular A-133 per the terms and conditions of UCAR's cooperative agreement with NSF. An external audit, coupled with a strong internal audit function and a well-conceived self-assessment program, would improve accountability at LBNL.

Recommended Action: LBNL should be authorized to follow OMB Circular A-133. Using a single comprehensive financial and operational audit would enhance mission focus, promote efficient and innovative work, improve laboratory stewardship, and implement site-specific solutions.

Authorize Laboratory Procurement under OMB Circular A-110 Guidance. The DOE–LBNL contract and DOE Acquisition Regulations (DEAR) govern LBNL procurement policies and practices. All LBNL purchasing policies must be approved by DOE and must be in accord with DEAR. At NCAR, institutional procurement policies are established following the guidance of OMB Circular A-110, *Administrative Requirements for Non-Profits*. At LBNL, with its adherence to DOE procurement guidelines, issues arise when standard DOE terms and conditions do not accommodate the needs of research sponsors. As an example, LBNL is required to flow down intellectual property clauses, which treat all programs as if they were DOE projects. Procurement policies dictate extra reports and flow-down provisions that could be eliminated if purchasing were done under Circular A-110. Terms and conditions could be modified to meet mission goals without lengthy case-by-case DOE approvals. The DOE rules require all subcontracts to look alike.

In general, procurement under Circular A-110 provides better management oversight (with fewer detailed agency transactional reviews), and the responsibility and accountability for procurements are more clearly established with the local contractor. The scientific mission benefits from less onerous terms and conditions and less external involvement in laboratory support operations, so that turnaround time, customer service, and efficiency can improve.

Recommended Action: LBNL should be authorized to manage procurements under the guidance of OMB Circular A-110. Improved accountability can be achieved through a combination of metrics and the management reporting process. The exemption of procurement from DOE directives would promote efficient and innovative support work.

Adopt DOE Management Oversight of the Personnel System. At NCAR, human resources (HR) policies and procedures based on industry and university best practices have been developed by HR professionals benchmarking against appropriate institutions. The National Science Foundation reviews substantive changes in personnel policy, as outlined in the cooperative agreement. The HR policies at NCAR are an integral part of its contractor-assessment process. The center is in the process of removing detailed procedures from its policy manual to further improve and streamline its HR systems. Compensation administration (other than the salary of NCAR's Director) is handled entirely by UCAR/NCAR. Accountability is maintained by the periodic NSF contractor review. At JPL, the HR programs and activities are integrated with Caltech activities. The JPL HR system is managed in a manner that meets the needs of Caltech while providing required information and reports to NASA. At LBNL, there is a highly prescriptive process for the DOE procedural review of all Human Resources Department transactions. The redundancies and reworking are neither effective nor cost-efficient.

Recommended Action: LBNL should develop laboratory personnel policies and procedures using the best examples from professional and industry standards. In place of procedure and transaction reviews by DOE staff, LBNL and DOE should agree to a defined set of reports and establish a methodology for DOE management oversight.

Counterintelligence and Security

Lawrence Berkeley National Laboratory is a DOE basic research laboratory (a Tier-III laboratory, according to terms stated in DOE Notice 142.1, Unclassified Foreign Visits and Assignments). The National Center for Atmospheric Research and JPL provide an array of counterintelligence and security comparisons, ranging from unclassified activities at LBNL to classified work conducted at other DOE national laboratories. In the context of the DOE security designation, JPL, for example, would be classified as a Tier-II laboratory because it conducts some classified research, and NCAR would be classified as a Tier-III site. Counterintelligence and security procedures at the three sites were examined to determine a number of factors that influence the cost, effectiveness, and efficiency of these activities:

- requirements of the sponsoring federal agency
- roles and responsibilities of federal agency representatives (at field offices and headquarters) and the laboratories
- the level of counterintelligence presence and federal security oversight provided at laboratories that do not perform classified research
- security and counterintelligence measures and federal oversight appropriate for a laboratory with either little or no classified work

A brief discussion of security and oversight at each laboratory follows.

NCAR

The National Center for Atmospheric Research performs no classified research and has no staff with security clearances. Its facilities are located in public areas with no fences or gates. It has no counterintelligence program. The annual budget for security is approximately $675,000. One and one-half NCAR FTEs are responsible for security. Physical site security for NCAR is provided by Barton Protective Services, the same subcontractor providing security for LBNL.

The NSF has issued no security directives and provides no specific security oversight. Management and oversight of security are considered part of the general management competencies, as written into the cooperative agreement between NCAR and NSF. The center follows standard industrial security measures and applicable laws, such as export controls and International Traffic in Arms Regulations (ITAR). A practice that works well for NCAR is the use of industry security consultants to periodically perform risk/vulnerability studies. Additionally, the security force subcontractor (Barton) is asked to provide ongoing risk assessments. The center's security management uses these assessments to implement appropriate security procedures. The use of industry security experts and standards

is a good practice that has led to an appropriate and cost-effective security program for NCAR. These industry practices include the use of available technology such as card access, alarms, and surveillance to implement a sound security program that protects people, property, and information.

Physical security measures for NCAR and LBNL are approximately the same. Unarmed guards provide some limited access control, and they perform periodic roving security patrols. Management at NCAR places no restrictions on foreign visitors except as provided by laws such as ITAR. Computer security imposes minimal restrictions on the open research mission. There is acceptance of some residual risk in both physical and computer security, so that security costs do not escalate far beyond potential losses.

JPL

At JPL, several hundred employees have Department of Defense (DOD) security clearances, but a minimal amount of the JPL program work is of a classified nature. Approximately 100 security staff members (including the fire department) and one counterintelligence officer report to the Site Security Manager, and the annual budget for this operation is between $5 million and $8 million. Physical site security is provided through a contract with Wackenhut Corporation.

One NASA security representative, stationed at JPL, provides federal oversight in the form of daily interactions with the Site Security Manager. There are also more formal Inspector General audits. The close interaction between the local NASA security staff member and the JPL Site Security Manager allows for addressing administrative and implementation concerns before they become significant management issues. Recently, JPL has added a counterintelligence officer who has a dual reporting relationship with JPL and NASA Headquarters.

There are five security-related directives or guides in the JPL contract. For classified work, NASA follows the *National Industrial Security Program Operating Manual* (NISPOM–EO 12829). The primary NASA guidance document, *Security Procedures and Guidelines* (NPG 1620.1), dated September 6, 2001, states the following:

> These guidelines are provided to assist NASA Center management in establishing local procedures to meet minimum security standards, requirements, and specification for the protection of NASA personnel . . . These guidelines have been developed to allow considerable flexibility, using established risk management strategies, to meet unique situations that may exist at NASA Centers.

Simply put, JPL site management has the flexibility to establish security or counterintelligence procedures to meet site requirements, addressing actual risks. This appears to work well. Site security personnel can tailor programs to the appropriate

level of security, based on specific site information, threats, and vulnerabilities. For example, computer security is stringent for the computer systems used to perform classified work or to control space systems. Similarly, physical security measures are commensurate with the information, property, and systems requiring protection. In addition, JPL has very strict access controls, and security officers are armed. Visitors must have an escort. The laboratory hosts a significant number of foreign visitors each year, and NASA Headquarters approves these visits. Moreover, NASA treats permanent resident aliens the same way it treats U.S. citizens.

LBNL

Lawrence Berkeley National Laboratory performs unclassified, public-domain research. No security clearances are issued by LBNL; however, approximately 60 employees have clearances in order to perform some classified work at other locations.

Counterintelligence support for these cleared staff members is provided through an agreement with Lawrence Livermore National Laboratory (LLNL), whereby a counterintelligence officer provides some dedicated support to LBNL. The LBNL staff supporting both physical and cybersecurity amounts to 9.2 FTEs. Of these LBNL security staff members, approximately 3.2 FTEs are dedicated to meeting DOE requirements. The annual budget for cybersecurity and physical security was $3.5 million in FY 2001. Physical security is provided by Barton Protective Services for both onsite and offsite facilities. There are approximately 20 unarmed security officers.

The laboratory's security operates under guidance provided through DOE orders and guidelines. Of the approximately 50 orders, policies, and guidelines on security-related matters issued by DOE, LBNL has adopted 14 into its contract. Numerous other DOE guidance documents are considered and analyzed for appropriateness at LBNL. Foreign visitors and guests are an integral part of the work at LBNL. Of the staff and participating guest population, approximately 1,300 are from foreign countries. At DOE and DOE laboratories, foreign visitors include permanent resident aliens.

Computer security is designed to support the open research environment that depends on collaboration, accessibility, and innovation. Protective cybersecurity measures are based on a cost-benefit model developed by LBNL. This best management practice allows LBNL management to make informed decisions regarding the resources allocated to protect computer systems and information.

Another effective management practice is the establishment of an Integrated Safeguards and Security Management (ISSM) program that defines roles and responsibilities for security. Essentially, ISSM states that both line managers and employees are responsible for security and that the institutional security programs have a staff responsibility to support the line in its security role.

Table 4. At-A-Glance Comparison for Counterintelligence and Security.

Organization	Security Staff (not contract)	Counterintelligence Staff	Classified Work	Security and Counterintelligence Budget	Number of Federal Orders or Directives	Number of Federal Staff
NCAR	1.5	0	None	$675,000	0	0
JPL	23	1	<2%	~$5 M to $8 M	5	1
LBNL	9	0.2	None	$3.5 M	14	1*

* One federal person assigned to the local DOE office is assigned to security; however, he is supported by several DOE/NNSA security professionals located at LLNL.

Best Practices and Recommended Actions

Use of National and Industry Security Standards. This best practice is employed by JPL and NCAR. On the other hand, LBNL has limited flexibility to implement such standards because of the numerous and prescriptive DOE standards. For JPL, NASA has issued a minimal number of directives, and they act as guidance that allows the site to tailor its programs to meet security requirements. Similarly, NCAR operates under no NSF security directives but considers security as a general management responsibility to provide a safe and secure workplace. Both sites have appropriate programs to protect people, property, and information. Benefits derived from using industry experts and standards have resulted in significantly lower security costs for NCAR.

Recommended Action: The Department of Energy and LBNL should agree on a pilot program whereby DOE security orders would be subject to a process similar to the WSS process before inclusion in the contract. This process would include executive orders and federal and state laws related to security and counterintelligence matters. Proven effective industry standards for physical security and cybersecurity would be adopted as appropriate. If a DOE policy, notice, or order were considered appropriate, it would be included as a contractual standard. If implemented, this action could result in cost reductions equivalent to 3.2 FTEs. Because of the increasing threats to computer systems (as evidenced by the proliferation of hacker activities, worms, and viruses), the effort expended on DOE computer security requirements would be redirected into more productive areas of cybersecurity.

Local Control and Direction for Security Programs. This practice appears to be working very well for NCAR and JPL. Partnering with the onsite federal sponsor on specific security issues is an effective practice for resolving issues and developing practical solutions that work for the site. The Jet Propulsion Laboratory has done this successfully. There needs to be an understanding between the federal sponsor and the laboratory on the frequency of the interactions, the type of information exchanged, and the expected outcomes.

Recommended Action: The DOE and LBNL security staff should develop an action plan that fully involves both parties on all security issues. This plan should address performance goals, information exchange, meetings, interfacing with DOE Headquarters, reporting requirements, site tours, adjudication of Headquarters requirements, conflict resolution, and reporting relationships. All aspects of security should be included under the umbrella of this agreement. This would include physical security, cybersecurity, export control, counterintelligence, foreign visitors, and foreign travel. The laboratory would then have the authority and flexibility to meet the performance goals by using best-management and cost-effective methods.

Independent Risk and Vulnerability Studies. These are an important adjunct to national and industry standards and local control. Contracting for physical security is used by the three sites and appears to be a cost-effective and successful method. Additional benefits may be derived by using the security contractor to provide risk and vulnerability studies, as NCAR has effectively done.

Recommended Action: DOE and LBNL security professionals should determine the feasibility, benefits, and costs of using industry security specialists to perform periodic risk and vulnerability assessments. Security peer reviews using security professionals from similar nongovernment research laboratories should be evaluated as an additional tool to validate assessments.

Use of Cost-Benefit Analyses. LBNL's approach to cybersecurity, using a cost-benefit model, is a good practice that allows management to make decisions on cybersecurity measures based on costs. The laboratory has shared this model among some DOE laboratories and is willing to share this methodology with other FFRDCs.

Recommended Action: DOE and LBNL should agree that LBNL would continue to use the methodology in the context of the recommendations above.

Integrated Safeguards and Security Management. This is a sound practice that integrates security into work planning and performance. It clearly defines roles and responsibilities and assigns line management the primary responsibility of protecting property and information. It provides a feedback loop to ensure that corrective actions are taken to address security deficiencies.

Recommended Action: DOE and LBNL should agree that this practice continue as one of the underpinnings of security at LBNL.

Environmental Health and Safety

The EH&S programs of NCAR, JPL, and LBNL were examined to identify and evaluate factors that influence the cost, effectiveness, and efficiency of the various EH&S functions at the three laboratories. Specifically, the study examined

- the EH&S requirements of the federal sponsor and other regulatory bodies
- the roles and responsibilities of the federal agency representatives (at site offices and headquarters)
- the roles and responsibilities of the laboratory for EH&S programs
- the level of and approach to EH&S oversight by the federal agency

The EH&S programs at NCAR and JPL both include and exclude aspects of the EH&S program activities at LBNL. Since EH&S programs are driven by the types and levels of workplace hazards and the worker risks associated with them, this examination also focused strongly on site hazard characteristics. For example, NCAR and JPL have minimal radiation work hazards and correspondingly less stringent radiation safety requirements than LBNL, which has an active accelerator research program and other research programs involving the use of radioactive materials on site. Conversely, both NCAR and JPL have significant work involving aircraft use, and both have appropriately rigorous efforts in flight safety. The following discussions of the EH&S hazards, programs, and staffing levels at the three laboratories consider these differences.

One set of metrics, TRC (the OSHA Total Recordable Case rate) and LWC (Lost Workday Case rate), is tracked regularly by many institutions. Though not a comprehensive metric on the entire EH&S program, we thought it would allow for meaningful comparisons between the laboratories.

NCAR

The NCAR EH&S staff of 2.75 FTEs consists entirely of industrial hygienists. The hazards at NCAR are generally limited to small-scale chemistry, lasers, some radiation-producing machines, a small number of sealed sources, machine shops, and equipment staging areas. The laboratory has no site contamination that drives either a Resource Conservation and Recovery Corrective Action or a Superfund program. The main hazards of NCAR's work may come from field work and are generally physical in nature. In this area, work hazards may exceed those of field work by LBNL researchers.

The center has an Institutional Safety Committee staffed with delegates from each of its divisions. Line management expects and gets meaningful participation, as well as good results, from the delegates. Line management is accountable for safety as at the other two laboratories, but the NCAR EH&S organization has the flexibility to help resolve safety problems regardless of circumstances. As with JPL and LBNL, NCAR has a sound EH&S self-assessment program designed for its own hazards.

The National Center for Atmospheric Research has a TRC rate comparable to LBNL's historic performance, but it uses total cost per accident as the primary metric. The center is proud of its efforts to reduce costs due to ergonomic accidents (approximately $1,000 per incident) and encourages early identification and treatment. A direct comparison to other laboratories was difficult because of differences in cost types, record-keeping systems, and state workers' compensation programs.

The National Science Foundation conducts an in-depth EH&S review once each five years as part of the contractor review and renewal cycle. The NSF reviews appeared to be very different from DOE inspections and reviews. There is no NSF presence on site. Though NCAR is subject to NSF agency oversight, inspections are less frequent than at either JPL or LBNL. Instead, NSF relies on the results of external regulator inspections and NCAR's self-assessment and safety program reports as assurances of sound EH&S performance.

JPL

The EH&S program at JPL has three elements: Environmental Affairs, Occupational Safety, and System Safety. System Safety mainly addresses flight operational hazards; since this topic did not relate well to LBNL, it was excluded from study comparisons. The other two JPL programs include about 40 FTEs, a staff composed of environmental professionals, industrial hygienists, occupational safety engineers, and support staff. These programs respond to common laboratory hazards, including hazardous materials, pressure systems, lasers, and small radiation hazards. There are also routine fire and seismic hazards and typical infrastructure shop hazards. The JPL site does have a Superfund program, but it is administered directly by NASA and was not addressed in this study. As with LBNL, a system of safety and environmental coordinators represent JPL units, and JPL's line management is charged with meeting safety and environmental commitments. The safety policy, generated by JPL, is entitled "Mission Success Starts with Safety." The laboratory also has an environmental policy. It has a self-assessment program, but it is not as extensive as LBNL's. The EH&S performance metrics at JPL focus on accident rates (TRC and LWC) and the costs of accidents and injuries. The laboratory tracks its TRC rate and recently reported a labwide performance of about 3.0; the LWC rate was about 2.0.

In the NASA Management Office, one staff member monitors EH&S performance and reviews results of external regulator oversight. The Jet Propulsion Laboratory does have triennial EH&S reviews conducted by NASA, but they were not at the same level of detail nor as rigorous as DOE's compliance reviews and program inspections. The laboratory designs its EH&S program to respond to its own workplace hazards and external agency standards. There are very few NASA-unique EH&S standards (NASA Issuances) in the JPL contract.

LBNL

The LBNL EH&S program consists of approximately 150 professionals, technicians, and support staff who implement a broad array of EH&S programs. Site access, security, health services, and fire protection activities are also included in LBNL's organization. Hazards at LBNL include radiation from accelerators as well as from a wide range of radioactive materials used in scientific research. Other significant radiation hazards are present from x-ray-producing machines and more than 100 (class IV) lasers. Significant chemical hazards exist in many research laboratories. Routine hazards exist from industrial shops, construction, and typical facilities maintenance activities. The laboratory also has significant seismic and wildland-fire hazards.

The laboratory has a strong EH&S program as measured by various internal and contract performance metrics. One set of metrics, TRC and LWC, however, has proven to be a challenging set of goals. Since 1993, the laboratory's TRC has ranged from a high of 6.0 (in 1994) to its best perfomance in FY 2001 of 2.4. The LWC ranged from a high of 4.0 (also in 1994) to a low in FY 2001 of 1.1.

The laboratory experiences nearly continuous oversight by six contributing staff members from the BSO and by other participating technical experts from OAK, with which BSO contracts for oversight staff support. Some EH&S inspection and oversight is also conducted by DOE Headquarters. The current system of local DOE oversight ("Operational Awareness") consists of frequent interactions between DOE staff and their LBNL counterparts throughout the year. In addition, LBNL is subject to frequent oversight visits by other federal, state, and local regulators.

The Department of Energy and LBNL use a contract administrative process to select EH&S standards appropriate to current worker hazards, public safety issues, and environmental protection risks. This WSS process is bilateral: DOE and LBNL form technical expert teams and evaluate each standard against the hazards present. The WSS approach has proven generally effective in reducing the numbers of EH&S work requirements unique to DOE and workplace standards to which LBNL is held accountable. There remain, however, some DOE-unique standards that offer little EH&S value to LBNL work but about which DOE staff have strong feelings of necessity. The Facility Safety/Authorization and the Occurrence Reporting programs of DOE are examples of this impasse.

EH&S Program Comparison

After reducing the EH&S organizations to a common basis (elements of a laboratory's program were excluded where they exist for hazards not present at the other two laboratories studied), one can derive the adjusted number of EH&S FTEs per 1,000 total organization FTEs. Table 5 shows this comparison across the three laboratories.

Table 5. At-A-Glance Comparison for EH&S.

Organization	Total EH&S FTEs	Adjusted EH&S FTEs	Total Organization Employees	Adjusted EH&S FTEs per 1,000 Organization Employees
NCAR	2.75	2.75	1,290	2.13
JPL	50	40[1]	5,200	7.69
LBNL	150	41[2]	3,830	10.71

[1]JPL program excluded: the Systems Safety Office (generally deals with flight operations hazards unique to JPL). Only the Environmental Affairs and Occupational Safety offices were included.
[2]LBNL programs excluded: Radiation Safety and Environmental Radiation Monitoring as well as the portion of the Waste Management program that manages LBNL's radioactive wastes and all of its legacy radioactive materials programs (LBNL has a comparatively large radioactive materials program, and it has accelerator programs that neither NCAR nor JPL has), Health Services (either not included in the other laboratories EH&S organizations or contracted out), Environmental Restoration (NCAR has no site restoration program; JPL, though a Superfund site, includes no restoration activities in its EH&S organization, as it is managed directly by NASA), Fire Department (NCAR does not have its own fire department, and JPL's is subcontracted), and all security functions within EH&S (studied in a different chapter).

This table indicates that LBNL's EH&S organization is larger than those of the other two laboratories. The reasons for this disparity include:

- **sponsor oversight:** In all EH&S areas, DOE oversees laboratory performance more closely than either NSF or NASA does. For example, NSF has one staff person (not on site) to oversee all operational aspects of NCAR, and the NASA Management Office at JPL has one staff member involved in onsite EH&S oversight. By contrast, there are six BSO people and many others from OAK involved part-time in oversight of LBNL operations.
- **public perception**: The DOE oversight role is affected by public perceptions. The public generally views NSF and NASA and their laboratories more favorably than they view the programs and contractors of DOE.
- **multiple oversight:** DOE has many layers of EH&S oversight. Primary oversight comes from BSO, but there are several overlapping DOE Headquarters oversight organization units. Two recent DOE Headquarters Environmental Monitoring and Transportation audits of LBNL are examples. The Jet Propulsion Laboratory has NASA sitewide inspections at about the same frequency as LBNL. The National Science Foundation's inspections are considerably less frequent.

Best Practices and Recommended Actions

Use Efficient and Effective Methods for Agency Oversight and Laboratory Accountability. Both NCAR and JPL have less direct federal agency oversight of EH&S performance than LBNL; yet the self-assessment reports, the workplace hazard levels, the frequency of noteworthy events, and significant parts of the EH&S programs are comparable for all three sites. Both NSF and NASA rely primarily on external regulatory agencies to conduct oversight and on NCAR and JPL to fully inform them about risks and results. Assurances also derive from intense but relatively informal management communications and occasional high-level evaluations. To date, neither NSF nor NASA has elected to intervene because of an EH&S event. The comparable parts of the EH&S organization at LBNL appear larger primarily because of DOE's individual scrutiny of workplace operations, detailed examination of low-risk hazards, and firsthand approach to oversight functions.

Recommended Action: DOE should adopt an improved oversight approach that relies solely on the BSO staff, LBNL self-assessments and reports, and external reviews. Further, LBNL should use a system to assess EH&S performance by using nationally recognized work criteria and performance metrics, the rigorous LBNL self-assessment program, and national industry and professional performance benchmarks. These actions could allow LBNL to reduce the size of its EH&S program by as many as 10 to 12 staff members in the program areas cited.

Follow a Bilateral Standards Adoption Process to Reduce DOE-Unique Requirements. Both NASA and JPL have a line-management-led and bilaterally implemented process for selecting requirements; this approach allows them to exclude inappropriate NASA requirements more effectively than does LBNL's WSS program. Lawrence Berkeley National Laboratory has been only partially successful in avoiding compliance with inappropriate DOE requirements and standards.

Recommended Action: DOE should implement a flexible, thoughtful approach to site adoption of DOE-unique criteria, employing a bilateral negotiation process similar to the NASA–JPL method.

Adopt Recognized External Standards for EH&S Programs whenever Possible. Both NASA and NSF rely primarily on external regulatory criteria and bodies for EH&S oversight at their sponsored laboratories. Both DOE and LBNL would be better served by adoption of nationally tested, recognized, and proven standards for EH&S programs. At LBNL, such a change should enhance EH&S performance while reducing oversight labor.

Recommended Action: DOE and LBNL should adopt a process where LBNL adheres to recognized external EH&S standards wherever possible and complies with DOE standards for EH&S criteria only when mission work hazards necessitate such compliance.

Continue and Advance Use of ISM Principles and Performance-Based Management Self-Assessment Methods. Lawrence Berkeley National Laboratory has a fully implemented ISM program and a mature EH&S self-assessment process. Used together, these programs provide valuable work safety guidance and valid performance data. These two programs are laboratory-management models for all DOE EH&S programs.

Recommended Action: LBNL should retain its current ISM and self-assessment programs and strengthen their activities, both to reduce perceived needs for more DOE oversight tasks and to provide improved assurance of EH&S excellence to DOE/SC.

Facilities and Infrastructure

Procedures and practices were examined at NCAR and JPL to determine a number of factors that influence the cost, effectiveness, and efficiency of site infrastructure activities as compared to those at LBNL. At the three sites, the following areas were examined:

- maintenance management
- condition assessment
- funding
- roles and responsibilities of the federal agency representatives (at field offices and headquarters) and the laboratory
- requirements of the sponsoring agency

In many ways, NCAR and JPL provide valid comparisons with LBNL and with other DOE sites of comparable size. For example, JPL and LBNL are of similar size in building and site area, both are built on hillsides, and both are restricted in space and in sites for new construction. Though NCAR has several campuses and is not as constrained in new site development or acquisition, it is otherwise similar in its infrastructure operation. The three laboratories are all fortunate to have good relationships with the corresponding offices of their federal sponsors. Each has achieved this in a different manner, but the benefits of this cooperation to the sponsor and the research are evident in all. A discussion of each laboratory follows.

NCAR

The NCAR main campus has more improved space than LBNL has and is larger in land area, but it has a very similar operations and facilities organization. The maintenance plan is developed each year from the data in the facilities management database and from direct observations. The database helps in analyzing the operations costs associated with individual components. Physical Plant Services (PPS) has an annual budget of $4.8 million. Plant operation and maintenance, engineering, and space management are funded by an occupancy cost pool, which is collected from occupants based on the area they occupy. Capital improvements are funded by special appropriations from NSF or by debt financed through municipal bonds. Capital funds may be carried over from year to year but must be spent on items within the project scope identified at the beginning of the project. Although NSF and UCAR do not set formal goals for NCAR performance, PPS subscribes to continuous improvement. Neither NSF nor UCAR has any reporting requirements for NCAR except in capital funding. Both progress and budget status of major directly funded projects are reported to NSF quarterly. The status of projects

funded by direct operational funds or by bonds is reported to the UCAR President's Council as requested. The center's relationship with NSF in infrastructure maintenance and elsewhere was excellent. Unlike JPL and LBNL, however, the sponsor (NSF) does not maintain an onsite presence at NCAR.

JPL

The Jet Propulsion Laboratory shares many features with LBNL, including size and space restrictions. The planning and administration of JPL maintenance is part of the Facilities Department function. The laboratory outsources maintenance and some maintenance-related construction work to a commercial company. This system works very effectively through an incentive contract that offers rewards for work quality and meeting performance goals. A subcontractor inspects 20% of the infrastructure annually, allowing the entire plant's condition to be surveyed every five years. The results of the condition assessment and historic data are used to plan maintenance work five years out from the current year. Like LBNL, JPL uses MAXIMO as its facilities maintenance program. In addition, JPL uses handheld computers to capture and download data, thus reducing transaction time, resource needs, and data entry errors.

Maintenance has an annual budget of $11 million for the operation and maintenance of the infrastructure, and an additional $1.5 million is budgeted for projects identified during the condition assessment. Projects over $500,000 are funded from a NASA Construction of Facilities budget. The relationship between the onsite NASA representative and the Facilities Department is good. The onsite representative is supportive of improvements made to the infrastructure and its management. The laboratory is on an award-fee contract and is evaluated by NASA once per year on performance, including energy conservation. Appropriate performance goals are passed through to Jacobs Engineering in an incentive-based contract. The National Aeronautics and Space Administration does not have a regular site visit and requires few reports. These are

- an annual self-assessment
- a report of real property (i.e., what has been built and what has been demolished)
- how much of the work accomplished was planned

LBNL

Lawrence Berkeley National Laboratory is a prime example of the physical infrastructure conditions typical of DOE's multiprogram Office of Science laboratories, and indeed, of the building conditions in many DOE and other federal research institutions. The five multiprogram laboratories are currently responsible for managing more than 1,700 facilities that include more than 16 million gross square feet

of building space. Roughly one-third of the laboratories' facilities are trailers or other portable structures. The majority of these facilities are old—approximately 70% are at least 30 years old—and many building and facility infrastructure systems have exceeded their estimated useful life expectancy of 25 to 35 years. In addition to normal aging and wear, most of the laboratories are also dealing with increasing maintenance and operating costs to address environmental, health, and safety hazards in older facilities. Facilities that are no longer in use—such as LBNL's Bevalac—require decontamination and decommissioning to make space available for future programs or to comply with environmental regulations.

The laboratory's main site comprises 200 acres in the Berkeley Hills and includes 1.6 million gross square feet of onsite facilities. Another 400,000 gross square feet of leased buildings is located in the cities of Berkeley, Oakland, and Walnut Creek. Capital funding is provided through several mechanisms, including General Plant Project (GPP) and General Purpose Equipment (GPE) allocations and line-item construction projects. The GPP projects are capital construction projects costing less than $5 million each with relatively short timeframes (24 to 30 months). The GPE funding replaces and upgrades general-purpose equipment (vehicles, heavy equipment, power equipment, computer and communications equipment, etc.). Line-item construction projects are capital construction projects costing more than $5 million and with a longer time frame (four or more years). Line-item projects can support general-purpose buildings, mission-specific laboratories, and utilities, depending on program sponsorship.

Each DOE/SC multiprogram laboratory has a "landlord" division that oversees implementation of laboratory-wide operational and infrastructure requirements and programs. The landlord for LBNL (High Energy Physics) funds $3.5 million per year for GPP and $1.97 million for GPE. The Director of the Office of High Energy Physics co-chairs a Laboratory Stewardship Committee with the BSO Manager to resolve issues facing the laboratory, including research and operational activities such as infrastructure work. The DOE/SC multiprogram laboratories also receive funds from the Science Lab Infrastructure (SLI) program, which provides line-item construction funding for general-purpose infrastructure.

Though well intentioned, the landlord relationship often causes program resources to compete against infrastructure investments, and it cannot address the scope of the investments required in order to modernize the laboratories. As the LBNL landlord, High Energy Physics provides the infrastructure support but only about 7% of the programmatic funding. The annual investment rate (noncapital projects, GPP, and SLI, excluding programmatic construction funds) is 1.2% at LBNL. A National Research Council report, *Committing to the Cost of Ownership: The Maintenance and Repair of Public Buildings* (National Academy Press, 1990), recommended that "An appropriate annual budget for M&R [maintenance and repair] for a substantial inventory of facilities will typically be in the range of 2 to 4% of the aggregate current replacement value of those facilities." Unfortunately, budgets in this range have not been available.

The laboratory's Facilities Department is responsible for the maintenance of the laboratory infrastructure and receives an annual budget of $11 million, some of which is received from the space charge levied on building occupants and other recharges. The Facilities Department work force consists primarily of LBNL employees. Most construction is contracted out. The trades, maintenance personnel, and engineering professionals number about 180 FTEs. Maintenance funds must be spent in the fiscal year they are appropriated, but capital funding may roll over. Condition assessments are contracted out, and 20% of the infrastructure is surveyed each year, allowing the entire plant to be assessed in a five-year period.

Appendix F of the contract between DOE and the University of California details comprehensive facility infrastructure program performance measures for the laboratory. Measures are consistent from year to year, but through annual DOE and LBNL negotiations, the metrics and gradients are adjusted. These measures include real property management, physical asset planning, project management, and energy conservation, as well as facility management and maintenance. Performance against these measures forms the basis of the Laboratory's annual self-assessment.

Other reporting requirements, excluding those for a specific project, are

- data from the Facility Information Management System (FIMS), compiled annually
- an annual maintenance plan
- the annual Comprehensive Facilities Plan
- the General Plant Project Plan, submitted whenever there is a change, but at least annually
- a report of all projects (capital and noncapital) over $500,000, submitted as necessary, but at least annually
- a report of funds expended on alterations to leased property

A partnership agreement is drafted each year and signed by the facilities representative for OAK, BSO, and LBNL.

Best Practices and Recommended Actions

Support for Modernization Must Be a Clear Priority for the "Landlord," and Resources Must Be Adequate to the Task. The "landlord" should coordinate needs and support from other DOE program offices that are major sponsors of research at LBNL. Though NCAR and JPL have similar infrastructure modernization needs, JPL has the advantage that the NASA Management Office is responsible for mission success as well as for A&O activities. In this case, the issue is not so much clear lines of authority and accountability between the federal agency and the contractor, but rather having a single sponsor

organization that can strike the proper balance between mission needs and related infrastructure needs. The National Center for Atmospheric Research has capital funding flexibility that is enviable. It is able to raise capital through a funding authority and repay the debt out of overhead. Such a flexible approach would become a best practice if a strengthened "landlord" approach were to prove inadequate.

Recommended Action: LBNL's "landlord" and the DOE program offices must move from the sponsorship of individual projects to the support of long-term programmatic goals and capabilities that include the necessary infrastructure to support the research. The DOE laboratories should work with DOE to gain support for the requisite increases in capital budget programs.

Use Contract Performance Metrics for Infrastructure Maintenance. Contract performance metrics in the UC Regents–DOE contract for the operation of LBNL have proven successful. Although all laboratories are dedicated to achieving the best possible performance, LBNL is the only one with a formal program setting specific goals in all areas of the department. Other DOE laboratories have used LBNL's model to develop their own programs. The advantage of a formal program is that it allows for tracking the same measure over several years, even if the gradients in the measure are changed.

Recommended Action: Continue use of the infrastructure maintenance metrics in Appendix F.

Use Incentive Contracts for Outsourced Maintenance. The incentive contract that JPL uses to subcontract maintenance has proven effective. It covers the quality of work as well as performance goals from the sponsor, allowing clearer contractor expectations, measurable results, and incentives to meet or exceed performance goals.

Recommended Action: Implement, where possible, the type of incentivized contracts that JPL uses for its outsourced infrastructure maintenance activities.

Construction Project Management

The Department of Energy plays a unique role in the nation's scientific enterprise by designing, building, and operating large and complex facilities for the benefit of the nation's academic, industrial, and federal researchers. Reports by the General Accounting Office, the DOE Inspector General, and others have addressed DOE's construction project management, including a report on *Improving Project Management in the Department of Energy* by the National Research Council (1999) in response to a congressional request. The department has responded to the NRC and other recommendations for improved oversight and management of projects in a variety of ways, including organizational changes and revised directives, most importantly DOE Order 413.3, *Program and Project Management for the Acquisition of Capital Assets.*

In view of the extensive national attention given to DOE construction project management in recent years, and the fact that there are few recently constructed special research facilities to compare directly among the three sites, we elected to focus on the funding, planning, design, and construction of conventional facilities common to all three sites and to examine those factors that influence costs, efficiency, and effectiveness:

- project management and planning-, design-, and construction-associated systems and service delivery
- funding, reporting, regulation, and oversight by the federal sponsor
- organization structure, reporting relationships, funding, and other business practices appropriate for laboratories that carry out similar types of research

The activities at NCAR and JPL provide comparisons that span the range of project management activities at LBNL. A brief discussion of some of the attributes of each laboratory follows.

NCAR

The National Center for Atmospheric Research's original facilities are centralized at the Mesa Lab site. Other facilities are distributed and are analogous to LBNL off-site buildings such as the Oakland Scientific Facility. The center's facilities are not clustered at one campus-like location. The use of industry experts (outsourcing design and construction services) and regional standards are practices that have led to contemporary and cost-effective facility design solutions for NCAR. Six staff members serve in project management and architectural and engineering (A&E) services.

Approximately three years ago, NCAR engaged in a restructuring of the facilities department. The facilities department now focuses on core facilities services; food services, security, traffic control, and mail and messenger services were spun off to another organizational unit. The facilities group downsized (primarily through attrition). More work is outsourced now, and heavier reliance is placed on "just-in-time" delivery of materials to avoid storage and stocking requirements. The center determined that its former, larger, in-house A&E staff provided a narrower range of capabilities than the contracted A&E services now provide. Almost all design services are outsourced at NCAR; this has provided an infusion of new ideas and possibilities.

At NCAR, NSF-funded work is reviewed quarterly. There is a direct line of communication between the facilities department and the responsible NSF headquarters individual.

JPL

The JPL site is similar to LBNL in general size and geography. Both occupy hillside locations adjacent to urban areas; both have aging structures in need of replacement. In 1997–98, JPL began to outsource: first security and fire protection services, then operations and maintenance of the physical plant. Staffed services at JPL include facilities engineering and construction, comprising project management, A&E, and construction inspection. During 1997–99, the JPL A&E/Facilities Project Management staff was reduced from about 60 to 40 through a layoff process. At present, there are about 15 to 20 professional architects, engineers, and project managers on staff at JPL. A separate department manages procurement. The JPL and LBNL project management and A&E service departments are somewhat similarly staffed.

The Jet Propulsion Laboratory coordinates with a single point of contact at NASA headquarters. This individual visits the JPL facility quarterly to review and inspect projects.

LBNL

The LBNL Facilities Department provides project management for conventional facilities. Project management, in-house architectural engineering, in-house mechanical engineering, in-house electrical engineering, and in-house structural and civil engineering are separate organizational subgroups within the Facilities Projects/A&E Group. The LBNL staff supporting project management and A&E services includes approximately 41 FTEs.

Guidance is provided through DOE orders and guides. Of the multiple orders, policies, and guides for facility planning, construction, and conventional facility project management issued by DOE, LBNL has articulated the applicable items in

its WSS set. In addition, certain requirements of the University of California also apply to the LBNL facility.

The laboratory's construction for DOE/SC is typically funded by congressional line-item appropriation for a program office or by DOE/SC's Laboratory Infrastructure Division through SLI. In either case, LBNL benefits from the experience of DOE/SC's Construction Support Division in the planning, design, construction, and operation of research facilities throughout the complex. In addition to this programmatic oversight, a local federal project manager works in the Berkeley Site Office, and external independent reviews are performed by the Office of Engineering Construction Management in DOE's Chief Financial Officer organization.

Table 6. At-A-Glance Comparison for Construction Project Management.

Organization	Project Mgt./ A&E Staff	No. of Buildings	Site Size	Laboratory Population	Approx. Amt. of Construction in Place Annually	Functions Included
NCAR	6 (5 professionals)	12 buildings at distributed sites	600 acres	1,200 FTEs	~$5 M	Proj. Mgmt, plan check/codes & standards, project records, space management/planning
JPL	43 (~15–20 professionals)	145 buildings	152 acres	4,750 FTEs	~$8–12 M	Proj. Mgmt., some A&E services, plan check/codes & standards, project records, inspection, some planning
LBNL	41 (29.5 professionals)	112 buildings (108 other structures and trailers)	200 acres	3,500 FTEs	$10–15 M	Proj. Mgmt., A&E services, job site superint., plan check, standards, record drawings

Best Practices and Recommended Actions

Streamline Construction Project Management. Streamlining construction project management through a single channel closely aligned with the programmatic mission resolves complex and overlapping lines of authority and improves project accountability. Direct communication with the DOE Headquarters sponsor on specific project issues is an effective practice to develop practical solutions that work for each site. One-to-one oversight systems minimize opportunities for miscommunication and cut down on the amount and type of reporting required. Direct communication lines to federal headquarters and informal, direct oversight and review of capital projects are typical at both NCAR and JPL.

Recommended Action: LBNL and DOE should create clear line accountability for construction project management based on alignment with programmatic mission responsibility.

Follow Standard Regional and Industry Practices. Tailor construction project management requirements and standards to site-specific, regional, and industry practices instead of agency-specific requirements and standards. Duplicative and conflicting regulations, standards, and practices have been estimated to add as much as 20% to project costs. Federal project management policy typically does not account for fragmentation and regionalization in the construction industry. National norms often ignore field knowledge, site-specific variables, and local construction market systems and traditions. New directives informed by the experience of one region may be difficult and costly to implement in another locale, especially if they are prescriptive about how they should be implemented. In the absence of many NSF-imposed project management, design, and construction criteria, NCAR has pursued a policy of standardization to match the local business practices of the design and construction industry. Productivity increases by in-house NCAR staff, design consultants, and construction contractors (subcontractors) have resulted. The JPL approach is through a bilateral requirement approval process; this process allows JPL to exclude sponsor-unique requirements that do not fit its situation or are costly to implement. Lawrence Berkeley National Laboratory uses the WSS process to articulate specific requirements.

Recommended Action: Following the JPL model, incorporate language into the LBNL contract that allows flexibility to tailor site-specific implementation of DOE and other federal requirements. Expand the WSS set to stipulate a bilateral approval process and acknowledgment of site-specific and Bay Area conditions.

APPENDIX A: Laboratory Participants in Best Practices Study

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Robert DeVelle, JPL, Manager, Construction Engineering

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Fred McNutt, JPL, Director, Business Operations and Human Resources

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Jeff Reaves, UCAR/NCAR, Associate Vice President, Business Services

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Dan Wilson, UCAR/NCAR, Director of Treasury Operations

Shawn Winkelman, UCAR/NCAR, Director of Information Technology

Glenn Woods, LBNL, Laboratory Counsel

APPENDIX B: Acronym List

A&E — architectural and engineering

A&O — Administrative and Operational

BSO — Berkeley Site Office

Caltech — California Institute of Technology

CAS — Cost Accounting Standards

CPA — certified public accounting

DCAA — Defense Contractor Audit Agency

DEAR — DOE Acquisition Regulations

DOD — Department of Defense

DOE — Department of Energy

DOE/SC — Office of Science

EH&S — Environmental Health and Safety

EPA — U.S. Environmental Protection Agency

FAR — Federal Acquisition Regulation

FFRDC — federally funded research and development center

FIMS — Facility Information Management System

FMC — Field Management Council

FTE — full-time employee

GAAP — General Accepted Accounting Principles

GASB — Governmental Accounting Standards Board

GPE — General Purpose Equipment

GPP — General Plant Project

gsf — gross square feet

HR — Human Resources

IG — Inspector General

ISM — Integrated Safety Management

ISSM — Integrated Safeguards and Security Management

ITAR — International Traffic in Arms Regulations

JPL — Jet Propulsion Laboratory

LBNL — Lawrence Berkeley National Laboratory

LLNL — Lawrence Livermore National Laboratory

LOB — Laboratory Operations Board

LPSO — Lead Program Secretarial Office

LWC — Lost Workday Case rate

M&O — Management and Operation

M&R — maintenance and repair

NASA — National Aeronautics and Space Administration

NCAR — National Center for Atmospheric Research

NNSA — National Nuclear Security Administration

NSF — National Science Foundation

OAK — Oakland Operations Office

OMB — Office of Management and Budget

OSHA — Occupational Safety and Health Administration

PPS — Physical Plant Services

R&D — Research and Development

SEAB — Secretary of Energy Advisory Board

SLI — Science Lab Infrastructure

SPO — Scientific Program Order

TRC — Total Recordable Case rate

UC — University of California

UCAR — University Corporation for Atmospheric Research

UCDRD — University Directed Research and Development

UCOP — University of California Office of the President

WSS — Work Smart Standards