

**Report on the Review
of the
Joint Genome Institute**

**Prepared by a Subcommittee of the DOE
Biological and Environmental Research Advisory Committee
(BERAC)**

July 2006

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....ii

TABLE OF ACRONYMS.....v

REPORT.....1

 Science.....1

 Management.....3

 Operations.....7

SUMMARY OF THE RECOMMENDATIONS.....11

APPENDIX A: Charge letter to BERAC from Dr. Orbach.....13

APPENDIX B: Roster of Subcommittee Members and Observers.....16

EXECUTIVE SUMMARY

Introduction

The JGI/PGF (Joint Genome Institute/Production Genomics Facility) is an outgrowth of the Department of Energy's (DOE's) leadership and participation in the Human Genome Project (HGP). The PGF developed as a state of the art production DNA sequencing facility with the task of completing the DNA sequence of a specific portion of the HGP. After the completion of DOE's portion of the HGP, the JGI/PGF focused its effort on applying high throughput genomic sequencing to major DOE program needs, *i.e.*, to the segment of the scientific community that was engaged with environmental microbiology, plant science, environmental monitors and the effects of radiation. The role of the JGI has become integrated and redirected to function as a user facility and as a lead organization in collaborations on DOE missions. A new memorandum of understanding (MOU) and a laboratory sequencing program (LSP) have defined specific roles and functions for the future of the JGI and its relationship with the National Laboratories. At this critical stage in the development of the JGI/PGF, the Director of the DOE Office of Science, Dr. Ray Orbach, has charged the Biological and Environmental Research Advisory Committee (BERAC) with organizing and conducting a review of the JGI/PGF to evaluate its present performance (Appendix A). The Director proposed a series of questions in three areas: science, management, and operations. The BERAC review committee was carefully chosen to include the appropriate expertise: three members represented three of the major sequencing centers in the world - the sequencing center at the Broad Institute, Boston; the Sanger Institute, Cambridge, England; and the sequencing center at Washington University, St. Louis. The committee included experts in molecular biology, microbial ecology, and genomic computation in order to provide insight into the scientific goals and products of the facility. In addition, a number of past and current Deputy Directors and managers from other National Laboratories and DOE facilities (Appendix B) were chosen to advise on management and operations. The committee spent two days (November 16-18, 2005) at the Walnut Creek PGF facility interviewing the management and meeting with the director of the facility, as well as touring the facility itself and having in depth interviews with staff and middle managers. A large amount of supplementary material documenting the operations, management and plans for the facility was prepared by the PGF staff. The report itself addresses each of the specific questions posed in the charge letter.

Summary

In the area of Science, the committee was delighted to find that with respect to scientific vision, the implementation of the role of the JGI as a user-facility and focus on DOE mission objectives, the JGI was doing very well. Furthermore, the PGF operates at the state of the art with respect to cost, quality, and quantity of sequences that it produces. The director of the JGI, Dr. Eddie Rubin, has outlined a role for the facility in leading "sequence-based science." He contends that the application of high throughput genomics and large scale sequencing provides a novel point of view, particularly in understanding environmental and energy issues. The JGI/PGF, in addition to becoming an effective user facility, has also pioneered collaborations and novel approaches to the area of metagenomics and has defined a unique niche for the PGF that does not overlap with other sequencing facilities and that is highly aligned with DOE missions.

The committee members pointed out a few areas in which there were concerns with respect to some of the components of the genomics sequencing process that were not as strong as they are at other facilities. "...however, the staff has recognized these deficiencies and made important strides to rectify problems... to a large extent, high throughput genomics is a constantly evolving business and the staff of the JGI/PGF are not experiencing anything unique among large scale sequencing centers. They have learned and are continuously learning how to manage these and other critical issues." The committee made a number of specific recommendations included in the full report. The committee also paid particular attention to the LSP and suggested that while this is potentially a very powerful program, a great deal of attention needs to be paid to executing it in a way that takes advantage of the JGI's strengths and focus.

In short, the committee felt that the JGI represents a major asset in the DOE's portfolio. It is engaged in first-rate science. It has focused on a niche where sequencing contributes to both pioneering basic science and to the specific missions of the DOE, particularly in the areas of energy, carbon sequestration and bioremediation. The committee looks forward to the further strengthening of the JGI/PGF, its integration with National Laboratory programs, and its role in facilitating the applications of genomic science to the DOE mission.

With respect to management of the JGI/PGF, the committee was highly impressed with the senior management team and with the operations staff and middle management. The questions posed by Dr. Orbach in this area are much more specific and led to a series of specific recommendations. Some of these are structural and can be implemented immediately. Their implementation is necessary for the efficient functioning of the organization. Thus, for example, it was recommended that a new MOU between Lawrence Livermore National Laboratory/Lawrence Berkeley National Laboratory (LLNL)/(LBNL) be drafted clarifying the roles and responsibilities relative to procedures regarding safety and cyber security. This should be given high priority by the directors of the facility and of the laboratories. There is also some concern that in the new LSP program, the specific roles, reporting relationships and organizational structure and the MOU might need further clarification. There are a number of functional areas that need to be strengthened as the JGI moves on to generate genomic sequences from higher organisms and specifically from complex plants. In general, however, the committee was very impressed by the management and effectiveness of the team operating JGI, even under complex multi-laboratory oversight.

With respect to operations, a number of specific recommendations were made, particularly in the area of safety procedures where the complex management of the JGI by two laboratories, LLNL and LBNL, causes potential difficulty. The committee recommended that the new MOU to be established between the two managing laboratories clarify the safety responsibilities and establish unambiguous guidelines for PGF employees. In addition, specific recommendations were made by the committee in order to facilitate the function of the user facility and enhance service to the microbiology community and to other users who will be involved in upcoming genomic sequencing projects.

The JGI/PGF is a vibrant, functional, productive unit of the DOE. It provides a tremendously useful facility currently being exploited by the microbiology community, and it will be able to play a major role in genomics studies for specific projects required by the DOE. The

management team is excellent and while there are a number of recommendations by the committee to facilitate the science, streamline the management, and make operations more efficient, on the whole, the JGI/PGF is a world class operation and a tremendous asset. As noted in the report, there are some areas of activity that need to be enhanced, while there are other areas for which development should be encouraged. Where appropriate, the activities at the JGI/PGF should be integrated into the research conducted at the National Laboratories.

TABLE OF ACRONYMS

BER	Office of Biological and Environmental Research
BERAC	Biological and Environmental Research Advisory Committee
CSP	Community Sequencing Program
DART	days away, restricted or transferred
DNA	deoxyribonucleic acid
DOE	Department of Energy
DOEMGP	Department of Energy Microbial Genome Program
EH&S	Environmental Health & Safety
FY	Fiscal Year
HGP	Human Genome Project
JGI	Joint Genome Project
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
LLNL	Lawrence Livermore National Laboratory
LSP	Laboratory Sequencing Program
MOU	Memorandum of Understanding
NIH	National Institutes of Health
ORNL	Oak Ridge National Laboratory
PGF	Production Genomics Facility
PNNL	Pacific Northwest National Laboratory
SAC	Scientific Advisory Committee
TRC	total recordable cases
UC	University of California
WFO	Work for Others

REPORT OF THE BERAC COMMITTEE TO REVIEW THE JOINT GENOME INSTITUTE

SCIENCE

1) Is the science conducted by the JGI/PGF cutting edge? How does it support the JGI/PGF role as a user facility?

- The scientific vision as expressed by the Director and staff is appropriate and inspiring. The JGI/PGF is proactive and conscious of the DOE mission in guiding the upstream process of project selection. The Director is positioning the JGI both to drive and exploit **sequence-based science** in applications that are novel, important, distinct and relevant to the DOE. It is expected that the JGI will have a major impact on non-human, non-medical biology.

- Science at the JGI/PGF, specifically the core business of production DNA sequencing is state of the art, innovative, and cost-competitive. There are a few minor concerns: some key components of the process are outsourced to other academic and government sites, there have been a few disconnects with clients/collaborators, and sequence quality was poor in past years. However, the staff has recognized these deficiencies and made important strides to rectify problems. They further recognize that more work needs to be done in the areas of sequence assembly, annotation, quality and customer support. To a large extent, high-throughput genomics is a constantly evolving business and the staff of the JGI/PGF is not experiencing anything unique among large-scale sequencing centers. They have learned and are continuously learning how to manage these and other critical issues.

The development of programs such as the Integrated Microbial Genomes are appropriate, much needed, and a contribution that should be further encouraged. The Director's concept of great science utilized to spread the impact of the user facility is a good one; he and his staff certainly grasp the fundamental concept. The committee expects that they will continue to have an impact on important areas of science and are conscious of the need to publish quality manuscripts in major journals. In addition to making sequence data available, they are investigating new ways in which those data can be applied.

- The scientific contributions made by clients/collaborators based on data produced by the JGI/PGF indicate that contributions are being made at several different levels; simple attribution as a source of sequence data, as well as primary intellectual contributions to new publications in first rate journals. In a number of areas, contributions leading to the development of new approaches to metagenomics grounded in sequence-based science (*e.g.*, the Banfield project) and large scale environmental library sequencing by the JGI are breaking new scientific ground.

2) How does the science conducted by the JGI/PGF support DOE mission and/or national interests? How does the JGI ensure an appropriate balance between mission-related sequencing and making DOE's unique resources available to the scientific community for basic research?

For the first few years after finishing its portion of the human genome sequence, the JGI seemed somewhat adrift in search of an appropriate niche. It now has a new sense of purpose, squarely

focused on science that would seem well aligned to the DOE's mission and the nation's interest. It may have taken longer for the JGI/PGF to arrive at this stage than other centers, although perhaps this is because it was required to find a completely new mission and areas of science. At present, it is well positioned to drive, support and participate in efforts that should utilize genome science to empower the fields of alternative energy sources, bioremediation, and carbon sequestration.

In its role as a User Facility Concept, the JGI/PGF is doing fairly well. It has established external peer reviews, feasibility analyses, and overall is clearly heading in the right direction. The staff members have been proactive in seeking and initiating projects that fit well with the DOE mission. The establishment of the Community Sequencing Program (CSP) is an excellent example. A proposed new portfolio of plant genomes should fit well into the overall mission. The committee noted that some of the tactical thinking was perhaps a bit naive with regard to genome complexity, however they will figure it out as they move forward with their new Maize project. Engaging the assistance of local plant geneticists would be an asset.

Likewise, more resources and expertise will be required for sequence assembly and annotation. There is good basic in-house know-how, but it will be overwhelmed by the quantity of data coming from the production facility. If not dealt with, this will result in long delays between the initiation of a project and the availability of a useful product, ultimately frustrating the users. Much of the annotation work currently is outsourced (*e.g.*, the Oak Ridge National Laboratory (ORNL) microbial annotation group) and thus out of the JGI's control. The JGI staff recognizes that this is a problem, however, currently there is no planned solution. Tools and personnel are needed to improve assembly and annotation, as well as to develop resources that will enable users to realize the potential of the data being produced. ORNL has tried to facilitate this in response to users, however, the entire area is understaffed. The committee recommends that this area should be a priority for the development of a strategy between JGI and ORNL to ensure that microbial genome annotation is able to keep pace with sequence production and that the user community can gain access to tools and training to utilize the sequence. Ideally, there should be a single initial point of contact for users to ensure that queries and feedback are logged and dealt with effectively.

3) What is the status of plans for the Laboratory Sequencing Program and how will it be implemented?

The committee believes that the LSP is an exciting program that represents an opportunity to provide a needed stimulus to encourage the National Laboratories to embrace sequence-based biology. Two potential projects were identified: the effects of low-dose radiation on the human genome, and plant and microbial bioenergy conversion. The committee was enthusiastic about the latter, but felt that the former overlaps significantly with National Institutes of Health (NIH) initiatives and does not fit well with the JGI's current core competencies. Three key areas were suggested that should fit well within the DOE mission and offer future opportunity to the JGI's strengths: genomes to energy, genomes to carbon sequestration, and genomes to bioremediation. The committee suggests that the Scientific Advisory Committee (SAC) should assist in aligning the LSP with relevant DOE missions.

The committee notes that the LSP needs to be executed effectively in order to realize its full potential. Accordingly, there needs to be an appropriate match between personnel and the program. The JGI Director eloquently expresses the mission of the LSP and clearly understands the work that must be done. However, the current LSP team leader does not report directly to the JGI Director. This was considered an inappropriate management structure. Furthermore, it was the committee's impression that the current LSP team leader does not sufficiently understand and/or communicate the mission of the LSP. The LSP has a noble purpose and represents an opportunity for interaction between JGI and the National Laboratories, [and further will involve generating cultural change at the labs, *i.e.*, stimulating the National Laboratories to explore the utility of sequencing to their science. As such, this will require a leader of missionary zeal and a much clearer vision of the specific ways in which this change can be implemented, as well as metrics for how it can be evaluated on an ongoing basis. The success of LSP involves aligning its leadership goals and missions to JGI. Lastly, the drivers for the LSP program must be the science. Therefore, it will be crucial for the program's success to have the LSP lead report to the JGI Director. With all of this in mind, the committee's recommendation is that a different person who reports directly to the JGI Director is needed in this position. Further, the JGI Director himself should be encouraged to help pitch this program to National Laboratory scientists. Top-down interest from DOE will further benefit this launch.

Recommendation: The JGI/PGF has been successful and is contributing at an excellent scientific level to areas of biology currently of great interest to the DOE. The JGI/PGF should continue to maintain and develop a state of the art large-scale DNA sequencing facility. In addition, the JGI has made great progress in developing useful databases and computational approaches to make sequence data useful and accessible. The JGI/PGF should be encouraged to continue to build resources in computational biology and to draw on the strength of the National Laboratories in the computational area both to enhance tools available to analyze sequence and go beyond to develop new approaches to sequence analysis.

MANAGEMENT

1) Are the JGI, PGF, and the management lab consortium's roles and responsibilities clearly defined and effectively carried out and coordinated?

The Director and Senior Managers of the PGF do a good job with the local facility (PGF), but they face formidable challenges with the larger and cumbersome five-laboratory JGI structure, which, as described, does not ensure accountability.

PGF is the physical facility in Walnut Creek; it is managed by LLNL/LBNL with employees of both laboratories (with approximately 50/50 representation) co-located at the PGF. The PGF organization has clearly defined roles and responsibilities, is staffed with highly competent managers, and appears to be functioning effectively. Integration of activities is occurring through matrixing, and PGF management handles issues in a pragmatic way. The current organization may not be optimal for the new, multi-user environment.

The co-location at the PGF of employees from two different laboratories, each with its own policies and procedures, including overhead recovery, can lead to confusion and procedural chaos. To avoid problems, an MOU between LBNL and LLNL was drawn up in October 1998 to spell out which procedures apply at the PGF. This appears to have worked, since no major issues have arisen in the interim. However, many DOE requirements have changed since the original MOU was drawn up, particularly in the areas of Integrated Safety Management and cyber security. Each of the laboratories has developed its own procedures, and since it has not been clarified as to which applies at the PGF, confusion (mostly in the form of duplicative effort) reigns. For example, the mixture of LLNL and LBNL Environmental Health and Safety (EH&S) policies, training requirements, and injury reporting and resolution is confusing and gives rise to redundancies. Further, the full scope of DOE requirements (*e.g.*, DOE Orders) for the two laboratories, as expressed in their respective contracts, potentially differ in significant areas. A new MOU is required and should be given high priority.

Recommendation: A new MOU between LLNL/LBNL clarifying roles and responsibilities relative to procedures, especially regarding safety and cyber security, should be given high priority by the JGI Director and the LBNL and LLNL Laboratory Directors.

The JGI is the five-laboratory (LANL, LBNL, LLNL, ORNL, and PNNL) partnership to coordinate Biological and Environmental Research (BER) BER genomics activities in the National Laboratories. The MOU for this partnership was signed on September 30, 2005, and the implementing structure will undoubtedly be refined as experience develops. The organization structure that was presented at the BERAC review appears to be cumbersome, dominated by multi-laboratory boards for management and science programs, and does not ensure accountability. Roles and responsibilities are not crisply defined, with some activities, for example, sequence finishing, being carried out at multiple locations using apparently distinct approaches and reporting. The JGI Director and the LSP Program Lead are depicted as equals, yet one has line responsibility while the other has a staff role (albeit an important one). Furthermore, the LSP is only 15 percent of PGF activity. This structure should be reviewed in light of establishing accountability with the required authority.

Recommendation: The JGI directors should review the organizational structure of the JGI to establish clear lines of authority and responsibility.

2) Is the way that the JGI/PGF management sets priorities, responds to BER imperatives, tracks progress, and resolves problems that impact laboratory operations the most effective approach?

The senior management team is outstanding! The members are most competent and dedicated to the achievement of the mission. The heads of the informatics group and the operations group are relatively new (the latter had been on the job only for two weeks before the date of the review), but both are highly qualified and great augmentations to the team. Management of the production sequencing effort is very effective, and the committee expressed tremendous confidence in the production area. Operations staff members seem to be very good, and middle level management staff members seem highly competent, in spite of the complex structure in which they work.

There is an emerging awareness of the need for comprehensive tracking and for the discipline of formal project management. Management sees this as an unmet need, and the committee encourages the PGF to continue developing competency in these areas.

Communications with BER are very good; the interface is well established and working. There are weekly management conference calls with BER, and a monthly sequencing report is supplied. The content of the meetings and reports evolves to meet the needs of BER.

3) Is the way that priorities are determined between BER needs, scientific community needs, internal science needs, and Work for Others (WFO) needs the most effective approach?

The Director and JGI Senior Management are doing an excellent job of assigning priority to sequencing projects in a way that reflects the JGI's mission and BER's interests while accommodating the needs and desires of a diverse research community with a broad spectrum of interests. The frequent and regular communication that takes place between the Director and BER is an important contributor to this. The mechanism to establish priorities among projects is effective and yet flexible enough to allow the JGI to respond rapidly to important new opportunities. Further, management has placed increasing emphasis on specifying the work that will be performed for each CSP activity and into managing the expectations of the research community. In the absence of this specification, some community members had unrealistic ideas about what could be achieved and the timeframe of delivery given the resources at hand. This will make the entire process more predictable and, hence, require fewer adjustments in priorities in response to community pressure. The JGI's ability to meet deadlines in a way that reflects priorities will always be vulnerable to its dependence on collaborators who provide DNA and other necessary materials and information.

4) Are the JGI/PGF plans to maintain its sequencing and genome annotation capabilities to the "best in class" standard the most reasonable and effective?

The JGI has built one of the premier production sequencing facilities in the world. It has done this through recruiting and retaining an extraordinarily skilled, multidisciplinary workforce at the Walnut Creek facility that strives to keep the JGI at the cutting edge of the relevant fields. The staff pushes itself constantly to improve JGI's capabilities and quality and to reduce costs. The staff has established an organizational culture that emphasizes the importance of the quality of the sequence produced, and there is therefore in place a working plan for constant innovation and improvement. In addition, the staff is kept at the cutting edge by the need to adapt to the continually changing demands of the new science that the group takes on. As noted above, this is a benefit of blending production and research staff at the JGI. Further, when JGI investigators apply for sequencing funds through competitive grants, PGF costs and other performance metrics are subjected to outside review and comparison to those at peer facilities. In short, it is clear that the JGI has the staff, expertise, and dedication needed to keep its sequencing facility operating among the "best of class."

It is less clear that the JGI is in a position to maintain this status with respect to genome assembly and annotation. While JGI's strength has historically been smaller, microbial genomes, future plans will have them sequencing increasing numbers of large genomes. The JGI needs to

prepare to make assembly of large genomes a routine, rapid, and successful process as it scales up these activities. This will require new research activities and then implementing the findings in new production informatics systems.

The committee expressed concern around JGI's performance and capacity for genome annotation. To most customers, the annotated genomes, not the raw or assembled sequence reads, represent the fundamental product of the JGI. Hence, the process for genome annotation must be as well organized and carefully managed as the sequence production. This is especially important because, as the rate of sequence output increases, so will the demand for more rapid genome annotation. As mentioned previously, the committee felt that the current organization of annotation activities, one with distributed responsibilities that remotely use the genome annotation system at ORNL, makes it difficult for scientists at Walnut Creek to manage genome annotation successfully.. This can be a distributed process, but it is perhaps better done in one place. This is a resource and priority issue. Annotation accuracy must also improve, both to ensure each new annotation represents state of the art methodology and to make better use of the wealth of newly emerging sequence data. Finally, new tools will be required to help users interpret new genome sequence in the context of the many other genome data that are available. It appears that the resources devoted to genome annotation may be inadequate and leave the JGI ill prepared for the impending large scale-up. Further, it is not clear that there is a plan for constant improvement of the quality of the automated annotations. This will require additional effort devoted to extending the capabilities of the current system.

Recommendation: The JGI should develop plans to implement a scalable process for assembly of large genomes. The JGI should further develop plans to: (1) reduce the time lag between the release of genome assemblies and annotations; (2) scale-up genome annotation activities; (3) extend the capabilities of the system in an ongoing fashion; and, (4) increase the transparency of the annotation process both to the Walnut Creek staff to improve their ability to manage it and to the wider user community. (See above – roles and responsibilities must be clear and resources increased).

5) Are there adequate resources to accomplish the BER mission at the JGI/PGF in the context of a flat budget (FY 2006 and outyears)?

The JGI staff members recognize that budgets are likely to remain flat, at best, in the out years and that therefore they will need to accomplish their ambitious goals to achieve more science with less money. Cost savings can be achieved in production sequencing where small incremental decreases in a per unit cost will save large amounts of money over the year while still meeting production goals. The PGF has an excellent cost reduction plan in place and constantly reprioritizes its target list for cost reduction to maximize the potential for savings. The leadership intends to shift these savings to address the Institute's greatest needs, which are considered to be production informatics systems and data analysis. The committee agrees both with the belief that sequence costs can be significantly decreased and with the appropriateness of shifting the funds to address computational needs. JGI leadership anticipates that to retain the scientific leadership needed to meet BER goals as well as the cost competitive position it holds currently with respect to sequencing, a significant capital investment will be needed in 2007/2008 to adopt new sequencing technology. The committee agreed that rapidly changing

sequencing technology is likely to necessitate a major capital investment in new sequencing instrumentation in this time frame. Further financial uncertainty is posed by the need to renegotiate the building lease, with these costs accruing in FY 2008, which assumes the availability of a sufficient budget. JGI leadership has already begun to explore the options and will work closely with staff at the University of California, the National Laboratories, and DOE, as well as with municipal officials of Walnut Creek.

6) Is the JGI/PGF's allocation and management of BER resources (manpower and funds) to achieve maximum impact the most effective?

JGI's management and allocation of BER's resources is very effective. The PGF is very well run, and its priorities are kept well aligned with BER's goals. The scientific and other goals of each project are clearly articulated along with their relevance to BER's mission. The committee perceived that the leadership at Walnut Creek has limited ability to understand and influence some JGI activities that are critical to its success, but that occur at other sites and for which there are distinct reporting relationships. The structure of the JGI is apparently intended to satisfy many desires beyond mere efficiency. However, JGI leadership has done an outstanding job of resource management despite these structural limitations. The committee was especially impressed with those resource decisions taken by the Director in expending the small fraction of discretionary capacity of the User Facility. These decisions were seen as having extremely high scientific and strategic value.

7) How are the BER missions at the JGI/PGF impacted by non-BER sources of Operations or Capital Equipment funding?

Although there are numerous non-BER activities at the JGI, there is great synergy in these projects running along side BER projects. Management is effectively leveraging the WFO activities in a way that complements BER projects. In short, there is no negative impact of the non-BER projects on the performance of the JGI mission, only a positive one. The Management is looking to increase WFO projects but will not do so at the detriment of the BER mission. The committee was impressed by management's ability and desire to balance the demands and rewards of non-BER projects against JGI's main mission.

OPERATIONS

1) Safety: Do JGI systems adequately foster safe operations, and ensure that ES&H and Security requirements are met?

The PGF has a number of unique challenges in its safety management at a location remote from either LLNL or LBNL, with a workforce comprised of employees from both laboratories and a mixture of production work and research. There are signs of duplication and contradiction due to different requirements from the two laboratories, which cause confusion and complaints from employees. An earlier MOU (June 1999) delegated "ES&H responsibility to the JGI Director" and assigned "ES&H technical support responsibility" to LBNL. It did not specify which laboratory's safety manuals, training requirements, or reporting requirements would apply. Not

too surprisingly, there appear to be ambiguities in the program, some of which will have to be resolved at high levels of management at the two laboratories. A consistent safety program addressing the PGF needs should be an important part of the new MOU between LBNL and LLNL.

Recommendation: It is imperative that a new MOU clarify the safety responsibilities of the two laboratories and that unambiguous guidelines be established for PGF employees. The PGF does not use the standard format of reporting incidents per 100 person-years for total recordable cases (TRC) and days away, restricted or transferred (DART). This is partly due to the fact that injuries for LBNL employees are reported to LBNL, and for LLNL employees the reports go to LLNL, resulting in an apparent inability to ascertain the total number of hours worked in the facility (the denominator in the rate calculations). Lines of communication about injury reporting and resolution are unclear, at times resulting in conflicting recommendations from LLNL and LBNL. There is not a current system in place to capture all injuries and resolutions in a single report, hence the Director of the JGI does not have the core input needed to assess the operations of the facility in comparison to other research facilities.

Recommendation: A system should be established such that the JGI director can get timely information on recordable and lost-time injury rates at his facility. Standard definitions for TRC and DART should be used.

Although the PGF does not have sufficient information to calculate accurate injury rates, it does have a database of the injuries that occur on site. The safety statistics for FY 2005 were far from best-in class, and the management has taken some laudable corrective actions. The safety coordinator now reports directly to the JGI director, and a safety committee that crosscuts the organization has been established. Senior and middle management has started walk-throughs, and the importance of safe work practices is a topic at meetings at all levels. These are good starts, but it is too early to determine the effectiveness.

A noteworthy effort has been the approach to address ergonomic injuries in the production facility. Since the work environment was different from the experience at either of the laboratories, their ES&H departments did not have the appropriate expertise. The PGF brought in an outside ergonomics expert who studied the work motions and prescribed new work procedures. This was a laudable initiative on the part of the PGF, but it reflects poorly on the oversight and assistance provided by the responsible EH&S department (LBNL according to the existing MOU).

2) User services: Does the JGI/PGF have appropriate procedures in place for identifying, reviewing requests from, supporting, and coordinating users? Does the JGI/PGF interact with users, both present and future, in the most effective and productive way, reflecting their evolving needs.

Yes, the JGI has an appropriate process for the user activities. The coordination of three user programs – the CSP, the DOE Microbial Genome Program (DOEMGP), and the LSP – is challenging. Each of these has a separate call and a separate review process. The overall time for each program is established by DOE. External peer review is a component of the process for

each, although with separate committees. The review committee for the CSP program was included in the review information; this committee has a large representation from the University of California (UC) system (both universities and laboratories).

Recommendation: Consider using the same review committee for all or part of the reviews. This would ensure uniformity in the review process. Organizing parallel coordination calls might also be more effective and should be considered.

Recommendation: Improve the demographics of the CSP proposal review committee. Having a large number of UC “winners” coupled with a proposal review committee dominated by UC staff could bring the independence of the review system into question.

JGI maintains user statistics that “count” all names on the successful proposals (also known as white papers[this is weird, in no other context does “white paper” mean successful proposal]) as users. There is no double counting of users (each individual is counted only once). This practice should be monitored by DOE to ensure that this statistic does not become skewed through “padding” of the author lists. An important metric for this facility is the sequence production, coupled with the cost metric that is standard for the industry. Likewise, impact as measured by publications is important as in all scientific research activities.

The JGI has a plan for its first user meeting in the coming year (March 2006). The plan is to establish a Users’ Executive Committee following this meeting that will serve as a communication channel with the users.

Recommendation: Get input from the users on the peer review process and implement suggestions that improve it. Solicit suggestions for review committee members, as well as for other advisory groups.

The formation of a project management structure as an approach to improve user interactions was applauded by the review committee.

Recommendation (appears elsewhere in the report): Extend the application of the project management approach more broadly to improve user service.

The JGI has a user survey that has been distributed for the first time. There was only a 20 percent response rate. Overall the responses that were received ranked the facility fairly well. The exceptions were the ratings for speed and quality of assembly and annotation, an area that is receiving attention from the JGI staff.

Recommendation: Distribute the survey on at least an annual basis. Consider other options to improve input from the users. Sending the survey when a project is completed might be a viable option and result in increased response.

3) *Business Practices: Do business systems and practices adequately ensure conformance with financial requirements and demonstrate sound business practices?*

Given the joint management structure, involving both LBNL and LLNL, the business systems and practices of the JGI appear to be very effective and commensurate with the mission of the organization. As an activity remote from both laboratories, the JGI has developed some business systems and practices unique to its operation. These systems appear to be appropriate and may need further development as the JGI continues its shift of emphasis from a primary focus on the human genome to a user facility. For example, modern project management techniques and systems could assist the organization increase its effectiveness and efficiency in performance, and tracking progress, of multiple user projects as the new operating style matures.

Recommendation: Expand the use of project management techniques and systems and appropriate staff training in the use of formal project management.

Since most of the JGI's day-to-day procurement activities are based on LBNL procedures and roughly half of the payroll is processed through LBNL, the JGI's business practices and systems closely mirror those of LBNL. However, the communications between the JGI's operations department and LBNL appeared to be limited to routine daily activities or the one major upcoming event, namely the expiration of the lease for the space occupied by the JGI. The JGI did not appear to be aware of recent new directions and systems requirements coming from DOE to its Management and Operating Contractors *e.g.*, OMB Circular A-123 implementation.

Recommendation: Establish a routine (monthly or quarterly) meeting between the JGI Head of Operations and his/her LBNL counterparts.

It was noteworthy that the recently hired, on the job about two weeks before the date of the review, head of operations appeared to have quickly established himself in the position both from a knowledge and a leadership perspective.

The committee did notice that many of the key function at the JGI were "one deep." This was made clear through the efforts described in hiring both the new Operations Manager and the Head of Informatics. Such lack of backup is expected in a small operation, and the JGI appeared to have successfully managed while these posts were vacant. However, a more conscious effort at cross training in management activities may be appropriate as the JGI moves further toward a user facility.

Recommendation: Develop a plan for covering senior level vacancies while replacement hiring is undertaken.

SUMMARY OF THE RECOMMENDATIONS

SCIENCE

Recommendation: The JGI/PGF has been successful and is contributing at an excellent scientific level to areas of biology currently of great interest to the DOE. The JGI/PGF should continue to maintain and develop a state of the art large-scale DNA sequencing facility. In addition, the JGI has made great progress in developing useful databases and computational approaches to make sequence data useful and accessible. The JGI/PGF should be encouraged to continue to build resources in computational biology and to draw on the strength of the National Laboratories in the computational area both to enhance tools available to analyze sequence and to go beyond to develop new approaches to sequence analysis.

MANAGEMENT

Recommendation: A new MOU between LLNL/LBNL clarifying roles and responsibilities relative to procedures, especially regarding safety and cyber security, should be given high priority by the JGI Director and the LBNL and LLNL Laboratory Directors.

The JGI directors should review the organizational structure of the JGI to establish clear lines of authority.

The JGI should develop plans to implement a scalable process for assembly of large genomes. The JGI should further develop plans to: (1) reduce the time lag between the release of genome assemblies and annotations; (2) scale-up genome annotation activities; (3) extend the capabilities of the system in an ongoing fashion; and, (4) increase the transparency of the annotation process both to the Walnut Creek staff, to improve their ability to manage it, and to the wider user community.

OPERATIONS

Recommendations: It is imperative that a new MOU clarify the safety responsibilities of the two laboratories and that unambiguous guidelines be established for PGF employees.

A system should be established such that the JGI director can get timely information on recordable and lost-time injury rates at his facility. Standard definitions for TRC and DART should be used..

With regard to selection of projects and sequencing targets, the JGI should consider using the same review committee for all or part of the reviews. This would ensure uniformity in the review process. Organizing parallel coordination calls might also be more effective and should be considered. Also, the demographics of the CSP proposal review committee should be broadened. Having a large number of UC “winners” coupled with a proposal review committee dominated by UC staff could bring the independence of the review system into question.

Input from the users on the peer review process for project choices should be obtained and suggestions that improve it should be implemented. Suggestions for review committee members, as well as for other advisory groups, should be solicited. The survey of projects should be distributed on at least an annual basis. Other options to improve input from the users should be considered. Sending the survey when a project is completed might be a viable option and result in increased response.

The use of project management techniques and systems should be expanded, and appropriate staff training in the use of formal project management should be implemented.

Routine (monthly or quarterly) meetings between the JGI Head of Operations and his/her LBNL counterparts should be scheduled.

A plan for covering senior level vacancies while replacement hiring is undertaken should be developed.

APPENDIX A



Department of Energy
Office of Science
Washington, DC 20585

Office of the Director

November 14, 2005

Dr. Keith O. Hodgson
Director, Stanford Synchrotron Radiation Laboratory
Department of Chemistry
Stanford University
Stanford, CA 94305

Dear Dr. ^{Keith}Hodgson:

The Biological and Environmental Research (BER) program supports the operation of the Joint Genome Institute (JGI), including the Production Genomics Facility (PGF), as a national scientific user facility. The JGI/PGF is located in Walnut Creek, California, and is jointly managed by a laboratory consortium presently consisting of Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Pacific Northwest National Laboratory, and Oak Ridge National Laboratory. The mission of the JGI/PGF is to provide highly efficient, cost effective, high quality and high throughput DNA sequencing for the scientific needs of programs supported by BER and for researchers needing access to DNA sequencing.

I am charging BERAC with organizing and conducting a review of the JGI, including the PGF, to evaluate its present performance in five areas: safety, management, operations, science, and user services. This will be both a programmatic review and an operational review. I request that this review be conducted as expeditiously as possible so that it can be discussed at the December 2005 BERAC meeting.

I would like the review to address the following questions:

Science:

1. Is the science conducted by the JGI/PGF cutting edge? How does it support the JGI/PGF role as a user facility?
2. How does the science conducted by the JGI/PGF support DOE mission and/or national interests? How does the JGI ensure an appropriate balance between mission-related sequencing and making DOE's unique resources available to the scientific community for basic research?
3. What is the status of plans for the Laboratory Sequencing Program and how will it be implemented?



Printed with soy ink on recycled paper

Management:

1. Are the JGI, PGF, and the management lab consortium's roles and responsibilities clearly defined and effectively carried out and coordinated?
2. Is the way that the JGI/PGF management sets priorities, responds to BER imperatives, tracks progress, and resolves problems that impact laboratory operations the most effective approach?
3. Is the way that priorities are determined between BER needs, scientific community needs, internal science needs, and Work-for-Others (WFO) needs the most effective approach?
4. Are the JGI/PGF plans to maintain its sequencing and genome annotation capabilities to the "best in class" standard the most reasonable and effective?
5. Are there adequate resources to accomplish the BER mission at the JGI/PGF in the context of a flat budget (FY 2006 and outyears)?
6. Is the JGI/PGF's allocation and management of BER resources (manpower and funds) to achieve maximum impact the most effective.
7. How are the BER missions at the JGI/PGF impacted by non-BER sources of Operations or Capital Equipment funding?

Operations:

1. Safety: Do JGI systems adequately foster safe operations, and ensure that ES&H and Security requirements are met?
2. User services: Does the JGI/PGF have appropriate procedures in place for identifying, reviewing requests from, supporting, and coordinating users? Does the JGI/PGF interact with users, both present and future in the most effective and productive way, reflecting their evolving needs?
3. Business practices: Do business systems and practices adequately ensure conformance with financial requirements and demonstrate sound business practices?

I very much appreciate your assistance in this matter. The insights and recommendations of your review team will be important to our future management of the JGI/PGF. I look forward to receiving your Committee's formal report no later than January 2006.

Sincerely,



Raymond L. Orbach
Director

cc:

A. Patrinos, SC-23
J. Decker, SC-2
L. Dever, SC-3
D. Thomassen, SC-23
D. Drell, SC-23.1

K. Lohman, SC-23.1
E. Rubin, JGI/PGF
J. Bristow, JGI/PGF
G. Fleming, LBNL
J. Wadsworth, ORNL
R. Mann, ORNL
D. Ray, PNNL
K. Balder-Froid, LBNL
D. Cobb, LANL
C. Ingram, BSO
P. Gilna, LANL
E. Branscomb, LLNL

**APPENDIX B - Roster of Subcommittee Members and Observers for the BERAC
Committee Site Visit at the Joint Genome Institute/Production Genome Facility**

BERAC Subcommittee

Mel Simon (Chair)
Biaggini Professor of Biology
Division of Biology 147-75
California Institute of Technology
1200 E. California Boulevard
Pasadena, CA 91125
(626) 395-3944
(626) 796-7066 fax
simonm@caltech.edu

Bruce Birren
Co-Director
Sequence and Analysis Program
NE125-2141
Broad Institute, MIT
320 Charles St.
Cambridge, MA 02141-2023
(617) 258-0913 (phone)
bwb@broad.mit.edu

Klaus Berkner
Deputy Director for Operations
Lawrence Berkeley National Laboratory (ret)
6680 Alhambra Ave #118
Martinez, CA 94553-6105
(925) 370-1865 (phone)
khberkner@comcast.net

Bruce Chrisman
Associate Director, Administration
Fermilab
Batavia, IL 60510
(630) 840-8447 (phone)
(630) 840-8752 (FAX)
chrisman@fnal.gov
mdixon@fnal.gov

Linda Horton
Director, Center for Nanophase Materials
Sciences, and Materials and
Engineering Physics Program
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6132
(865) 574-5081 (phone)
(865) 574-4066 (FAX)
hortonll@ornl.gov

Richard Mural
Chief Scientific Officer
Windber Research Institute
Windber, PA 15963-1331
(814) 467-9844 ex 307 (phone)
(814) 659-7545 (cell)
r.mural@wriwindber.org

Jane Rogers
Director of Sequencing
The Wellcome Trust Sanger Institute
Wellcome Trust Genome Campus
Hinxton, Cambridge, England
CB10 1SA, UK
44 122 383-4244 (phone)
Jrh@sanger.ac.uk

Jim Tiedje
Center for Microbial Ecology
540 Plant and Soil Science Bldg.
Michigan State University
East Lansing, MI 48824-1325
(517) 353-9021(phone)
(517) 353-2917 (FAX)
tiedjej@msu.edu

Richard Wilson
Director, Genome Sequencing Center
Washington University St. Louis
Campus Box 8501, Rm. 4122
4444 Forest Park Ave.
St. Louis, MO 63108
(314) 286-1804 (phone)
(314) 286-1810 (FAX)
rick@geneman.wustl.edu

BER Staff

Dan Drell
Life Sciences Division, SC-23.1/GTN
Office of Biological
and Environmental Research
Office of Science
US Department of Energy
1000 Independence Ave., SW
Washington, DC 20585-1290
(301) 903-4742 (phone)
(301) 903-8521 (FAX)
Daniel.drell@science.doe.gov

Kent Lohman
Life Sciences Division, SC-23.1/GTN
Office of Biological and Environmental Research
Office of Science
US Department of Energy
1000 Independence Ave., SW
Washington, DC 20585-1290
(301) 903-0353 (phone)
(301) 903-8521 (FAX)
Kenton.lohman@science.doe.gov

NHGRI Observer

Jane Peterson
Associate Director,
Division of Extramural Research
National Human Genome Research Institute,
National Institutes of Health
5635 Fishers Lane
Suite 4076, MSC 9305
Bethesda, MD 20892-9305
(301) 496-7531 (phone)
(301) 480-2770 (FAX)
petersoj@exchange.nih.gov