Project Summary

The project consisted of the deactivation and demolition of Building 51, Building 51A, and the Bevatron accelerator at the Lawrence Berkeley National Laboratory in Berkeley, CA. The project scope also include the disposal of, approximately 30,000 tons of radiologically activated material, remediation of contaminated soil within the building footprint and engineered enforcements of containing walls. The objectives of the project were to remove the largest building at the laboratory, remove hazards posed by the structure and the accelerator, reduce the burden on laboratory resources, and make the Building 51 site available for future reuse.

The project was completed on February 2012, which was within schedule and was able to return more than $2.4M to the Office of Science (approved TPC was $50.0M at CD-2/3 and final TPC was $47.6M at CD-4). The project also met the waste diversion goal of more than 75% of recyclable waste. Although Building 51 was a decaying facility, and there were inherent demolition hazards, more than 230,000 hours were worked with no lost time and only one recordable injury.

The three biggest successes for this project:

Lessons Learned—Successes	Description, Impacts, and Solutions
"Threshold" and "Objective" values	• Using Threshold and Objective values for Key Performance Parameters for project completion criteria, as allowed by DOE Order 413.3B and defined by DOE Guide 413.3-5A, provided a means to achieve success without definitive knowledge of the level of environmental remediation that was required. • Threshold and Objective values were established as part of Project Execution Plan and included as Key Performance Parameters. The project KPP set 1900 cubic yards of soil cleanup as a Threshold Value while an Objective Value was set at cleaning all soil to institutional reuse standards. • Project met KPP of 1900 cubic yards of soil clean and was not held to further remediation. Had further remediation been required, the project schedule and budget may have been at risk.
Retired personnel involvement	• The use of personnel who are experienced with the facility and its operations, specifically, the part-time involvement of the retired Bevatron operations manager Mr. Bob Miller, was an excellent strategy for both LBNL and the subcontractor. • Involvement of Mr. Miller resulted in increased efficiency due to his knowledge of assembly and disassembly processes, methods and tools. Had Mr. Miller not be involved, the subcontractor would have required additional time to determine the most efficient means for demolition. • Potential hazards regarding disassembly were also outlined, likely resulting in improved safety during the project. • Establishing a relationship with similar experienced personnel early in the project, during characterization if possible, should be planned for all demolition projects.
Unit rates for unknowns	• Addressing unknown quantities in bid documents with unit rates reduced the risk and contingency the bidders would have been required to include within the required fixed-price bids • The RFP required that bidders include unit rates if waste quantities were outside the predicted range, i.e., more or less activated concrete shield blocks, more or less activated steel, and more or less PCB-contaminated or VOC-contaminated soil. • If unit rates were not used, then bidders would have included additional contingency to cover the added risk resulting in increased costs. • The unit rates were used when the variation did not result in a cardinal change to the project which reduced change order effort. (Also see other lessons learned below.)

Three significant areas of potential improvement and how it might have impacted the project:

Lessons Learned—Potential Improvements	Description, Impacts, and Solutions
Improve sample analysis limit expectations	• Although there were clearly defined minimum detectable activity levels (MDAs) in effect at the time of the request for proposal (RFP), the contractor collected a sample that was not required, did not discuss or vet it by the project management, and sent it to a lab without providing that lab with clear guidance as to the required MDAs. • The lack of project-approved MDAs on this sample resulted in testing to standards more rigorous than required and ultimately declaring some materials as radiological waste that may not have been necessary. If the subcontractor had clear MDA expectations to follow, then the largest cost and schedule changes for this project could have been avoided. • The project should be involved with reviewing and approving sample collection to ensure that the sample is needed, properly collected, and properly analyzed to assure data quality objectives are met.
Improve hazard characterization	• A Reconnaissance Level Characterization Report and Hazards Maps were created under the original project team, which occurred several years prior during an earlier phase in the overall demolition project of the facility. Prior to the start of this final phase, several project team member changes occurred, leading to the loss of much of the undocumented knowledge and associated information. • Because it is a specialty and because of staff workloads, the reconnaissance-level characterization effort was provided by subcontractors. Being a specialty, one firm was not able to handle both the radiological and the non-radiological characterization. An important aspect of interacting with a qualified subcontractor is to get a plan that follows a prescribed methodology that is tied to the historical use of the buildings and to include internal subject matter experts in the development of any such sampling plan. • A reconnaissance-level characterization is not intended to provide a complete picture of the material hazards present. Due diligence on the part of the demolition subcontractor when the actual work is done is expected and should be noted in both RFP and contract documents. • Further sampling, specifically for sub-slab foundations and soils, early in the planning or demolition phase of the project would have been advantageous. Access for this type of sampling may have been difficult, but earlier characterization would have resulted in less impact during subcontractor demolition activities resulting in fewer cost and schedule changes.

Lessons Learned—Potential Improvements	Description, Impacts, and Solutions
Improve subcontractor submittal expectations	• The quality and timeliness of submittals should be clearly set in the contract documents. Set the ground rules for document preparation and submittal expectations before issuing the notice to proceed. • Poor performance on document submittals resulted in increased effort by the reviewing and approving organizations, with the associated cost and schedule impacts. The project found that it let inadequate subcontractor work products pass during the review for Notice To Proceed based on verbal agreements, and that same lack of document preparation and sophistication set the tone and standard for documents produced by the subcontractor through the life of the project. Not having to repeatedly review, comment, and frequently rewrite substandard subcontractor documents would have resulted in cost savings for the contractor. • Solutions may include specifying that the subcontractor cannot proceed with a particular phase or task until the specified documents have been submitted and approved. Firmness with the subcontractor on these contractual commitments is needed. Setting payment milestones to ensure quality submittals/work performed may be considered. Also consider requiring sample documents as part of the bid package or incorporate within the contract/award process to allow evaluation of the documents. Express importance of quality and timeliness of documents. If they exist, provide examples to the subcontractor of deliverables that meet expectations.

Other lessons learned for this project:

Lessons Learned	Description, Impacts, and Solutions
Hazard documentation	• In reviewing documents and requirements, do not assume all historical information is still accurate. Information collected needed to be re-reviewed, approved and researched further before accepting and incorporating it into RFP documents. Reports used should have been only a starting point for further investigation with the new project team leads. Err on the side of asking questions about historical information. • On the positive side, the Hazards Maps were updated and included in the RFP documents. The maps were also useful in obtaining DOE approval to proceed with the project. Future projects may consider planning for interviews with previous team members if projects are split among various phasing that could result in team member changes.

Lessons Learned	Description, Impacts, and Solutions
O413.3B tailored approach	• The project was able to take advantage of the DOE Order 413.3A requirements. Utilizing the design/demolition approach, the project was able to work within the tailored approach as defined in DOE Order 413.3A and combine the Critical Decision (CD)-2 and CD-3 reviews. This allowed for savings of time to conduct the review and of effort to prepare for a separate review.
Order compliance verification	• The project team and the BSO failed to identify that the quantity of stored radioactive material required the development of authorization basis documents or justification that the authorization basis documents were not required. • The decision was made to prepare the authorization basis documents which required that a Safety Assessment Document (SAD) and an Accelerator Safety Envelope (ASE) were required before the CD-2/3 review; preparation of these documents became a critical path activity. • Verify DOE Order compliance early to ensure all required documents can be adequately prepared and approved. Independent DOE Order compliance crosswalk would have been good.
Differences in working with small business	• Contractors should recognize that demolition subcontractors and/or other small businesses often have a different approach, resources, and level of sophistication when compared to construction general contractors. • Recognizing these differences can help to ensure that contractors and DOE expectations in these areas are established early in the project.
Improve interdepartmental communications	• Contractor Groups/Departments/Divisions should work together to improve interdepartmental communications. Hiring of the dedicated project Radiological Control Technician (RCT) took longer than anticipated. The hiring process was delayed, because of last minute decisions not to use contract RCTs to augment the LBNL Radiation Protection Group (RPG) staff and to hire a term employee. There were few resumes submitted for the position, as other DOE sites, such as Hanford and Savannah River, were hiring numerous RCTs at the same time. The first candidate selected used the LBNL offer to leverage more money from his current employer and backed out at last minute; the second choice candidate had found another job by that time, which required collecting more resumes before filling the position. • Because the interviewing and selection process was slower than the project had planned, there was a change in the assigned RCT personnel after the initial phases of the project. Although the loss of consistency and partial coverage did not create long term problems, they could have been avoided entirely. • Improving communications would have ensured sufficient time to hire

Lessons Learned	Description, Impacts, and Solutions
	appropriate project support personnel.
Improve schedule development	• The schedule provided by the subcontractor did not sufficiently plan for potential weather impacts. • An allowance for weather impacts must be included within the subcontractor's schedule, for example including rain days for each of the winter months. • The subcontractor's schedule did not break-out schedule contingency, rather their risk planning was included within individual activities. • Although having the subcontractor specify contingency was not required in the project contract documents, defining the risk and documenting the amount of remaining schedule contingency would have improved understanding of laboratory's risk. Also, if the schedule risk was explicitly documented in the schedule, then negotiation of several of the change orders for which the subcontractor was seeking schedule variance would have been easier.
Safety oversight planning	• ES&H oversight was scheduled into the project from early in the planning phases; the type and quantity of the estimated effort was addressed in the project ES&H Oversight Plan. Commitments were provide for the project by the Environmental Services, Fire Services, Industrial Hygiene, Occupational Safety, Radiation Protection, and Waste Management groups of the EH&S division. • Support and services provided by the respective ES&H groups met or exceeded expectations, in some cases requiring efforts greater than estimated. • The early recognition and concurrence regarding the anticipated ES&H effort aided planning and provided additional assurance that support would be available.
Authorized release limits	• The use of authorized release limits was suggested for this project, however the approval of authorized release limits could not be assured within California and even if so, likely would have resulted in a schedule delay. • A possible benefit to future projects would be to evaluate whether or not authorized release limits (as opposed to the default no man-made radiological material added) would benefit the project and if so, seek authorized release limits early. • Due to the restrictions currently in place within the state of California, this would likely be a benefit only in other states.
Funding strategy	• The strategy used with the Funding Profile, specifically the way money was accumulated and the project was put on hold in order accumulate enough funds to proceed with the project without multiple

Lessons Learned	Description, Impacts, and Solutions
	phases/interruptions of mobilization and demobilization, worked very well. • Although risky, it was beneficial for LBNL to go to DOE to adjust/suggest the above method. • Prior to implementing this strategy, the project was not able to make any significant progress, and encountered numerous personnel changes and inefficiencies.
Subcontractor selection process	• The subcontractor was selected based on "Best Value" criterion. This resulted in completing the bid selection process without any complaints filed. Only one bidder requested a de-briefing. • There was a sufficient turn out of bidders providing fair and comparable bids. Several companies called after the close of the bid period indicating the possibility for broader advertisement in future bids. • Use of the best value selection criteria should continue for this type of contract.
Subcontractor training	• LBNL successfully provided project/site specific training courses for the subcontractor. • Initial training of project personnel, specifically in the areas of Radiological Worker and General Employee Training, were accomplished by LBNL on a project-favorable schedule. Subsequent training was provided by the subcontractor, after their training material received a substantial review by RPG, and RPG determined that the revised training was LBNL equivalent. • Establishing sufficient contractor training resources as part of project planning can help ensure subcontractors meet training expectations and requirements.
Full-time safety professional	• The decision to have a full-time safety professional on the LBNL team was a great benefit. Although the subcontractor's safety professional was also a benefit, the subcontractor's safety personnel have a potential conflict between job safety and customer satisfaction. • The additional safety oversight from the contractor, including both the full-time, project-based personnel and the part-time, off-project EH&S Division personnel, helped to reinforce job safety.
Improve incorporation of bidder proposal into contract documents	• Although the bid documents required bidders to include unit rates in their proposals for some work (see project successes above), the bidder's unit rates were not included in the final contract document nor did the contract include by reference the RFP or the Clauss proposal documents. • By including the bidder proposal and the RFP in the contract several subsequent scope questions would have been avoided. Importantly,

Lessons Learned	Description, Impacts, and Solutions
	without the unit rates contract negotiations were required when additional activated shield blocks were identified.
Improve key personnel requirements	• More levels of key personnel, roles and percent time on project identified in subcontract should be included considering the Best Value approach. • The relatively few key personnel requirements established in the bid documents allowed the subcontractor to change personnel or reduce personnel involvement. It was discovered after the selection was made that the subcontractor had a noted lack of project controls and planning expertise. • Contractor specifications could have been improved by more clearly identifying expectations regarding key project personnel, project controls and scheduling products and resource requirements.
Improve Safety Incentive program expectations	• The safety incentive program required by the contract was not implemented as anticipated. Although the contractor provided safety milestone awards to the entire team in the form of some work-day safety luncheons and some after-work events, the application of safety incentive funding toward individual or spot awards was limited. • The implementation of individual and spot awards on another LBNL project, the User Support Building, was a better example of a good practice. • If future programs are established, then LBNL should consider self-administration of the program or defining the program expectations more thoroughly in contract documents.
Budget for site support services	• Some site services and work orders should be anticipated throughout the course of the project. Examples include utility location services, work orders for performance of lock-out/tag-out, work orders for maintenance of peripheral systems and components affected by demolition activities. • It is impractical to preplan every detail for every phase of the project; accordingly, sufficient budget should set aside for the laboratory support of these in scope activities.
Plan Of Day meeting format	• The subcontractor's Plan-Of-Day (POD) meetings proved useful and were acknowledged as the expectation for all LBNL Capital Projects. • Although the initial POD meetings were adequate, feedback and subcontractor experience produced improvement over time. • The POD meetings are recognized as a vital element in the implementation of Integrated Safety Management; the continued use of the POD similar to those used on the project will aid safety awareness at the laboratory.

Lessons Learned	Description, Impacts, and Solutions
Penetration (dig) permit process	• Preparation of penetration (dig) permits improved over time; initial permits placed significant restrictions on the work that could be accomplished in view of abandoned or de-energized lines. • Dig permits were prepared with specific allowances to improve work flow, for example, a permit might specify that abandoned lines were expected and that after receiving LBNL construction manager concurrence work could continue without changing the permit, or specify that minor damage to a de-energized (or non-hazardous) system was acceptable provided the damage was repaired before penetration operations were completed. • Obtaining individual dig permits for each excavation could have been a time consuming and expense process. In lieu of multiple dig permits, the project successfully demonstrated that the building was isolated from all live utilities and that excavations within the building footprint could be performed safely. Based on this demonstration, the project obtained a variance from typical permit restrictions for both duration and affected areas. The global dig permit was approved for all work that was contained within the building and was issued for the planned duration of the project.
Sharing approved vendor list	• Provide the subcontractor with LBNL's approved vendor list, or similar, at commencement of project could be beneficial. • LBNL project requirements state that sub-subcontractors must be approved by LBNL, however the sub-subcontractors that are known to be acceptable were not identified. Also, a few sub-subcontractors selected by the Clauss team were marginal. • Sharing the approved vendor list and other LBNL feedback prior to Clauss selection could have saved Clauss from the issues resulting from below par sub-subcontractors.
Subcontractor involvement with risk planning	• The subcontractor may identify risks, mitigation strategies, and potential impacts not considered by the contractor. Quarterly or semi-annual input from the subcontractor could be beneficial. • Projects should consider involving the subcontractor once in a while during risk planning. This must be done in a separate session where confidential risks are not shared with the contractor.
Early vetting of project requirements	• To the extent possible, clear definition of the project requirements prior to or early in the project can greatly enhance the chance of success. The project must thoroughly vet the project criteria including applicable code, standards, and regulations. • Involve appropriate subject matter experts for advice and counsel early in the design phase. This requires care, as it can be unproductive to attempt too much detail in a specification.

Lessons Learned	Description, Impacts, and Solutions
	• A robust process needs to be established for selecting firms for architectural and engineering services. • The review and evaluation of potential Architect/Engineering firms should be based on: qualifications of key personnel; relevant recent experience; performance on previous projects; and ability to perform requested services.
Clearly define subcontractor roles and responsibilities	• Roles, responsibilities, and expectations should be clearly identified at the onset of the project. For example, the percentage time that subcontractor personnel are to be assigned to the project should be clearly identified during the subcontractor interviews, and then documented in project documentation. • For this project, it was sometimes unclear which individuals within the subcontractor team were responsible for activities, requiring multiple communications among the subcontractor's management team. • One means to achieve this would be to require a subcontractor document analogous to the LBNL Oversight Plan and which would delineate the roles, responsibilities, and percentage effort planned for different phases of a project.
Improve subcontractor's project planning	• The Statement of Work for a large construction project must include a requirement for the preparation and implementation of an integrated work plan utilizing an activity-based resource loaded schedule. The baseline construction schedule must be agreed to early in the construction phase. • Continual attention and regular updates to the resource loaded schedule is critical since not all General Contractor subcontracts will have been awarded at time of baseline. Also, the minimum level of effort by the scheduler during specific phases of the execution should be specified to ensure schedule updates are produced in a timely fashion. Without proper and consistent updates, risks associated with the subcontractor's plan may not be recognized with sufficient time to develop corrective actions or contingency plans.
Schedule for characterization	• When it is not practical or practicable to complete site characterization prior to the preliminary design stage, for example the under-slab soils were inaccessible due to the accelerator; allowance should be made to complete characterization activities when areas become accessible. And although project contract documents required some time to be set aside to perform soil characterization, the time was not sufficient to allow completion of the characterization when new contaminants were identified. • The project risk planning included possible cleanup of previously unidentified under-slab contaminants but should have also included

Lessons Learned	Description, Impacts, and Solutions
	allowance for the characterization; specifically, risk planning should acknowledge that subcontractor activities may need to be paused while characterization is completed. • Future contract documents should consider a longer duration for characterization than the 5-days allowed for LBNL characterization on this project.
Improve change order timeliness	• When Change Order work cannot be avoided every attempt must be made to resolve cost and schedule impacts as soon as practicable. The project must ensure substantiating documentation is received in a timely manner for Change Order resolution. • Contract provisions establishing the process for Change Orders must include a time frame for submitting the information as well as options that the project may take if the information is not forthcoming. This is especially important for Change Order work that deletes scope and results in a credit to the owner. Change Order work should be forward-priced to the greatest extent possible. Negotiate the cost and schedule impacts prior to releasing the work. When Change Order work is schedule critical and must be done immediately due to unknown field conditions, a Field Change Order process can facilitate the progress of the work and mitigate potential schedule delays.