



Lessons Learned from Design-Build of the NREL Integrated Biorefinery Research Facility

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Statement:

The Department of Energy's National Renewable Energy Laboratory (NREL) completed the design and construction of a research facility in Colorado in 2011. The Integrated Biorefinery Research Facility (IBRF) project was developed and performed in a two phase process: 1) preliminary design, and 2) detailed design and construction. There were numerous lessons learned for this project that could be applied to similar construction line item projects with Total Project Costs in excess of \$20M.

Discussion:

The Department of Energy's National Renewable Energy Laboratory is the only federal laboratory dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency technologies. The mission of the NREL is to develop clean energy and energy efficiency technologies and to practice and advance related science and engineering, and the laboratory provides knowledge and innovations to integrate energy systems at all scales.

NREL's Integrated Biorefinery Research Facility (IBRF), a 27,000-ft², high-bay biochemical conversion pilot plant accommodates bench-to-pilot-scale processes for converting cellulosic biomass into a variety of fuels and chemicals. This facility enables researchers and industry partners to develop, test, evaluate, and demonstrate processes for the production of bio-based products and fuels—all with a focus on reducing performance risk and improving the commercial viability of new processes.

Due to funding constraints, the IBRF was constructed in two stages. Stage one consisted of the construction of a 27,000 square foot building with a high bay and associated process equipment. This was completed in 2010. The second stage consisted of additional high-bay process equipment, 3,800 square feet of modified lab space and a new 11,900 square foot office building. This stage was completed in August 2011.

Analysis:

Starting with development of the Request for Proposal, through the design and construction of the facility, there were numerous observations made regarding performance on this project. The following highlights some of these observations:

- A list of project objectives was generated during development of the RFP. The list was divided into three categories – “mission critical, “highly desirable” and “if possible”. The list was used in the competitive procurement process for bidders to accomplish within a fixed price budget.
- Prior to release of the RFP, a draft was generated and issued to the bidding community for comment on the realism of the scope, schedule, budget and technical content. In addition, during the proposal phase, one-on-one meetings with individual offerors were held to ensure the proposal response to contract requirements was fully understood.
- An award fee program was developed for the Design-Build contractor, however, it was difficult to quantify the fee when scoring was performed.
- During the first phase, of the project, Preliminary Design, it was determined that there was insufficient funding for the entire project. The second phase was then divided into two Stages in order to be able to efficiently utilize existing funding.
- The safety record of the facility during construction was excellent due to a dedicated safety professional who conducted safety tours and inspections
- There were several incidents of equipment failures during commissioning which impacted the project schedule which were caused by lack of maintenance actions on temperature sensitive equipment during construction.
- Several OSHA requirements for machine guards were not incorporated into the fabrication of process equipment.
- Scope changes were necessary at the end of the project after much of the management reserve and contingency had been released.

Actions:

The design and build of NREL's Integrated Biorefinery Research Facility led to the following lessons learned:

- Incorporate a strong safety culture early and into all phases of the project, from developing the RFP through construction and commissioning.
- Start the project risk management plan during the pre-CD-0 (project planning phase) and ensure it is comprehensive and provides sufficient management reserve and contingency to support the scope of work through project completion.
- Utilize best practices to obtain complete and appropriate proposals, to obtain competitive pricing and to implement an award fee incentive program.
- Plan complex one-of-a-kind design-build projects like those associated with new research and development facilities as two stage acquisitions.
- Determine and schedule DOE project review requirements well in advance to ensure CD-2/3 authorization is not delayed.
- Standardize performance requirements for various aspects of the project such as commissioning, energy, security, environment, health, safety, quality, etc.
- Have a dedicated QA Subject Matter Expert (SME) actively engaged in the project to ensure project quality.
- Utilize a design-build acquisition strategy to improve schedule performance.

Critical Decision(s): CD-0 through CD-4

Facility Type(s): Commercial Research and Development Test Facility

Work Function(s): Design, Project Management, Construction, ESH&Q

Technical Discipline(s): All



Artist's Rendering of IBRF



Stage II High Bay Process Equipment

References:

1. NREL Website: NREL Expands Biofuels Partnerships, February 28, 2011 http://www.nrel.gov/news/features/feature_detail.cfm/feature_id=1493
2. NREL Website: Integrated Biorefinery Research Facility, Advancing Biofuels Technology <http://www.nrel.gov/biomass/pdfs/44997.pdf>
3. NREL Website: Integrated Biorefinery Research Facility Lessons Learned – Stage I Acquisition through Stage II Construction Completion August 2011 <http://energy.gov/management/downloads/integrated-biorefinery-research-facility-ibrf-i-ii-post-cd-4-eere-aug-2011>
4. Merrick & Company Website: Integrated Biorefinery Research Facility, National Renewable Energy Lab, Golden, CO http://www.merrick.com/Portfolio/Integrated-Biorefinery-Research-Facility?industry=Industrial_Biotechnology_en&service=