AdvanceTEC
Cleanroom Design and Construction

White Paper
Case Study

Cambrex Bio Science Process Development Lab Expansion

Developing innovative solutions when preliminary requirements and budget do not match

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Abstract

When a project's preliminary requirements and budget do not match, something needs to change. This document provides a case study of how Turner Construction and AdvanceTEC worked with Cambrex Bio Science to develop an innovative solution to this challenge, and deliver a cleanroom that met user requirements and budget mandates.

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The Challenge

In the Summer of 2002, Cambrex Bio Science Baltimore, Inc. commissioned a 3rd party engineering firm to develop a Basis of Design (BOD) document for the 30,000 square foot expansion of their process development laboratories at their Baltimore facility. The expansion, to be located within an existing warehouse building adjacent to their manufacturing plant, consisted of:

- 9,000 square feet for offices
- 13,000 square feet of laboratory area
- 8,000 square feet of mechanical support space

Unfortunately, the project's preliminary needs and budget did not match. The budget required a nearly 30% reduction at a total savings of nearly $1.5 million, yet the user group could not sacrifice any of the preliminary requirements of the BOD.

Cambrex's decided to take a unique approach to delivering the project. Utilizing the BOD as the basis of a request for proposal (RFP) and as a starting point to deliver the intent of the facility design, Cambrex's solicited design-build proposals from several companies. Within the RFP was the requirement to propose value engineering alternates to meet the user requirements and the target budget of $4.2 million.

Turner Construction Company teamed with AdvanceTEC, a firm specializing in delivery of design-build cleanrooms and laboratories, to address the challenge of the project. They assembled a project team that focused on a deliverable that met the intent of the BOD – without sacrificing space, functionality, or the Cambrex budget.

The Selection

Cambrex's evaluation team interviewed all proposing companies and selected the Turner / AdvanceTEC team as they presented the most innovative approach to achieving Cambrex's desired facility. In addition, they displayed the most flexibility in working openly with the client to achieve their goal while maximizing their investment.

Design Modifications

Once the project team was assembled, they set out to value-engineer the facility design without downgrading functionality, and while keeping in focus the eight-month project duration mandated by Cambrex management. The design team from Turner Construction and AdvanceTEC re-evaluated the utility and redundancy requirements to maximize savings. The results of the evaluation yielded a $1.5 million savings, as redundancy was considered a luxury that the project could not afford.

HVAC Savings

The first major savings was incurred through the decision to change the HVAC in the administrative areas from a chilled water design to a direct expansion unit. While operating costs would increase slightly, the change allowed for the downsizing of both the plant steam and chilled water systems, as well as allowing for the optimum placement of the unit. This significantly reduced the installation and duct costs. Additionally, during the procurement process, a pre-packaged HVAC unit that had been ordered for another area project but never utilized was discovered. It met the project capacity requirements and was purchased at a cost of $20,000 less than the price of a new one. All told, this change netted a $250,000 savings from the original budget.

Now that the HVAC for the lab areas were going to operate independently from the administrative spaces, the lab HVAC could be redesigned as well. The concept of a central HVAC mezzanine for all systems was revised and replaced with a floor-mounted system in the mechanical space. Additionally, the concept of a central air handling unit and elaborate duct distribution system with VAV boxes for individual labs was replaced by a system utilizing a central make-up air handler and individual modular climate changers that

served each lab independently. This design resulted in the individual labs utilizing the same amount of control points and thus maintaining the functionality, but afforded the labs individual operation with significantly less ducting and a more evenly distributed structural loading. The more evenly distributed loading afforded a structural reinforcement budget savings of over $100,000.00.

Steam System Generation

In conjunction with the downsizing of the plant steam system, the method of generation was re-evaluated. The original design included a system operating using natural gas. However, the existing warehouse building had no gas supply and the nearest main was located approximately 1,000 feet away. A cost analysis revealed that the use of an electric boiler would increase annual operating costs by less than $10,000. This was justified by the $20,000 in savings on the purchase of an electric unit versus a gas-fired one, as well as the $500,000 that was saved on the installation of a dedicated gas service.

Lab Layout

Once the systems had been sized, the design team attacked the lab layout to achieve more economical routing of air and pipe systems. Again, the intent of the BOD and the process flow were not compromised. Wet services were moved together within the lab layout to utilize common utility delivery chases and minimize service runs. This change affected the deionized (DI) water system, plant and clean steam, compressed dry air, process chilled water and the process gases (O_2, N_2 and CO_2). The internal layouts of the labs were re-programmed to minimize the amount of underground existing in-slab piping. The result was a savings of 150 linear feet of floor drains, the associated reduction in slab cutting and patching, and a reduction of the utility delivery service of nearly 2,000 linear feet. These changes contributed a savings of nearly $250,000.00 to the project budget.

Additional Design Modifications

In addition, 20-25 smaller items were evaluated, with 10-15 of those items deemed feasible and implemented. An additional $100,000 to $150,000 in savings was realized through these miscellaneous items.

Additional Savings

The design changes alone left the team $400,000.00 short on the goal of $1.5 million in savings. The Cambrex engineering staff set out to achieve the final goal. The user group and design/build team was assembled to re-evaluate facility finishes and specifications to identify additional savings. After further discussions with the user group, several material specifications and finish detail requirements were revised to meet the target budget.

DI Water System

The DI water system loop piping was further evaluated and determined not to require stainless steel piping. Polypropylene piping was substituted, which met all requirements of the users.

Flooring

Flooring within the laboratories was revised from seamless vinyl to rolled on 40 mil.

Equipment

The design/build team searched the surplus equipment market and identified a reconditioned autoclave for the project, which allowed for the transfer of $100,000.00 from the equipment to the construction budget. Finally, the size of the glassware washer was re-evaluated and reduced at a savings of $40,000.

Schedule Coordination

While the design team was carrying out the extensive value engineering process, the construction team was charged with creating a construction schedule that maintained the overall eight month duration of the project, while

absorbing the impact of a four week design schedule requiring eight weeks. The construction team, comprised Cambrex, Turner Construction, and AdvanceTEC representatives created a detailed construction sequence that anticipated and communicated staged deliverables from the design team. This allowed for the overall extension of the design process, while shortening the construction schedule to meet the original expected completion date.

Key Factors

There were two key factors in shortening the construction schedule: 1.) the elimination of the required structural modifications to the existing building, and 2.) the use of modular wall systems instead of a standard stick-built approach.

The elimination of the structural support system required mounting of items previously designated as roof mounted equipment to be set on the perimeter ground, thus allowing for earlier installation and tie-ins.

The use of modular wall systems allowed for factory fabrication concurrent with preliminary site work. It also significantly decreased the requirements for on-site interior finish systems. These two items provided enough time savings to more than make up the additional time spent in design.

Cambrex's commitment to the schedule was imperative to the success of this team process. Early on, the Cambrex engineering team insisted that lab cards be re-developed to insure the revised systems' design were appropriate and accurate. The user group participated in the review of the lab cards, to achieve buy-in across the board throughout their organization. A design cut off date was established and communicated to all members of the process. The date was published and hi-lighted within the schedule to insure all parties were aware of it. No design changes were entertained after the cut off date. This regimented process insured researchers were available and participated in the lab card review meetings when they were scheduled.

Eliminating Structural Modifications

The key factor in shortening the construction schedule was the elimination of anticipated structural modifications to the existing building. These modifications were eliminated once the detailed investigation of the existing structure was completed and the design concept was modified to a modular type design.

This concept allowed for factory fabrication of wall panels while preliminary site work was being performed, and significantly reduced site finish work, resulting in a one month reduction in the site construction duration. In addition, the mechanical delivery systems were downsized, and the roof mounted equipment was relocated to perimeter ground once the floor plan was reoriented within the building to allow for proper process flow and access.

Working in Parallel

The aggressive schedule dictated that the construction team pre-purchase all long lead equipment while the detailed design drawings were being completed. Once the subcontractors were selected, the long lead items were assigned to the appropriate trades for receipt and coordination. Subcontractor bid packages were released in conjunction with the construction sequence, while plumbing and HVAC packages were broken into smaller pieces such as drains, plumbing, hi-purity process, HVAC ducting, and exhaust systems.

This modular approach afforded the design team additional time, where required, and still allowed the construction team to maintain the bid schedule. All bidders were interviewed with mandatory attendance by a principal of the proposing firm to assist in identification of scope gaps and/or misinterpretation of their required scope of work. These interviews were also used to review the schedule requirements of the contract and receive commitment from key members of the subcontractors' organizations.

A detailed comparison spreadsheet was developed for each bid package, and the entire project team reviewed the comparisons and

selected the subcontractors. This approach resulted in less than 1% change orders on the project from award to project close out, including items requested scope changes by the owner.

Construction

Once construction began, the construction team worked pro-actively to ensure the schedule was maintained. Turner and AdvanceTEC's site superintendents met daily with the owner to update work activities. Progress was tracked on the site drawings, color coded by day, and cross-referenced to the construction schedule. When construction issues surfaced, the superintendents were charged with assembling a representative from Cambrex, Turner, and AdvanceTEC to review the issue and provide a solution to the team. Decisions were made expeditiously, and the team moved forward.

The construction schedule was updated and published weekly by Turner and AdvanceTEC, and reviewed in their weekly site subcontractor meeting. Critical period's required detailed sub-schedules. Some tasks, such as factory start up and training, required hourly breakdowns to insure coordination issues did not produce unproductive time for team members. When subcontractors were not on schedule, the construction team evaluated man loading and adjusted appropriately. A weekly owner's meeting was held to update the Cambrex staff and discuss critical path issues.

The Results

The full project team was committed to delivering a high quality finished product for Cambrex that met the user's needs. The result of this commitment was a project that was delivered on schedule, under budget, and with less that 1% change orders. The construction team's zero punch list approach resulted in project close-out and sign-off within two weeks of substantial completion. Since project completion, only one minor missed requirement has been discovered and was promptly resolved. Most importantly, as a group, the Cambrex staff is extremely pleased with the facility and the value delivered.

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Michael Wisler is the director of engineering services for Cambrex Bio Science Baltimore, Inc., which specializes in providing contract development services and clinical and commercial scale manufacturing to the biopharm industry.

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Susan Boggs is the business development engineer for Turner Construction Company, Mid-Atlantic Bio-Pharmaceutical. Turner specializes in providing solutions for complex projects in several delivery methods and services.