GROUP Contractors LLC:

Laboratory Hardening at Valero St. Charles Refinery

The four-month fast-tracked "hardening" of a 12,500-square-foot laboratory facility at Valero Refining Corporation's St. Charles Refinery is testament to how experience, teamwork and a well-defined constructability process can turn a formidable project into a success.

Completed and planned expansions at the refinery had increased the risk that the six-year-old laboratory facility, centrally located in the refinery, could sustain serious structural damage in the event of a catastrophic explosion. By hardening the structure with new interior and exterior structural steel components, the project team has ensured the building will remain structurally intact, thereby protecting the 20 or so occupants that typically work inside.

Daily communication was essential, as a lack of building schematics for the pre-engineered metal building required that the project team make critical on-site adjustments to new column and purlin locations during construction. Additionally, GROUP often worked 20 ft. high within the ceiling of an operating 20-person lab in a highly flammable area amidst mechanical ductwork and other unknown ceiling components.

Through constructability exercises, GROUP Contractors worked hand-in-hand with engineer and architect to find ways to shave money from the $2 million budget, **ultimately reducing the project's cost by 65 percent** (final cost was $687,711) and completing the project in just over four months. The project team reviewed construction processes from start to finish, thereby identifying obstacles prior to construction and preventing errors, delays and cost overruns.

Challenges during the cost-plus project were numerous:

- An upcoming planned mega-expansion at the plant necessitated a very rigid timeframe for completing the work.
- Work was complicated by the need for the laboratory to remain operational throughout the project. Daily communication between project team members was essential to ensure that Valero employees' productivity was unaffected.
- Structural steel columns, new purlins and braces had to be maneuvered through the existing building – often down narrow corridors – and installed as high as 20 ft. within the interior ceiling.
- While less than a decade old, the pre-engineered metal building had very few detailed schematics available, resulting in a multitude of unforeseen delays and obstructions that required quick design changes in the field. The design was tweaked frequently to align the new steel columns and purlin braces with existing building components. This required frequent meetings with owner and design representatives to make necessary design adjustments, while ensuring that structural blast load requirements were met.
- The flammable work environment prohibited the use of welding or cutting equipment inside the facility. An on-site fabrication shop was used to make necessary alterations, rather than wait for an offsite facility to perform the work.
- The project team was challenged to find ways to shave project cost, all the while maintaining a rigorous fast-tracked schedule.

GROUP became involved early in the project, examining various options with Baker Engineering and Risk Consultants Inc. on the value engineering of the structural components, and with WGD Architects of New Orleans on the cosmetics. Making the project more cost effective was the goal from the beginning.

Other options (that were later rejected) included extending the footprint of the building; adding framing, lateral supports and bracing; adding steel or concrete shielding; or retrofitting the building from the inside. With GROUP's assistance, the team determined that the most cost- and time-effective option would be to erect additional structural steel, purlins and braces at strategic locations both inside and outside the structure. The method was also the least intrusive to workers within the facility. "Throughout the constructability process, we looked for ways to minimize disruptions and downtime for the workers," said Steven Chustz, GROUP project manager.

Construction was completed under a tight timeline: the project mobilized on February 1, 2013, with scheduled and actual completion on June 23, just four short months later. To meet schedule, GROUP often worked seven days a week.

“Because of the timeline, we began construction as the design was still under way,” Chustz said.

Construction

The Valero facility contains a large laboratory, offices, breakrooms and restrooms. The lab, used to test production samples from the refinery, is occupied 100 percent of the time, so it was imperative that the construction plan allowed for the facility’s continued operation. “There are people in and out all day long,” Chustz said. “On average, about 20 Valero employees work there.”

To determine the number, location and size of the structural steel needed to meet blast load requirements, Baker Engineering and Risk Consultants (an industry leader in developing blast design standards) analyzed the building’s existing structural and façade elements to identify areas that might present a debris hazard. Utilizing a variety of proprietary software tools, engineers incorporated data from architectural and structural drawings, as well as on-site assessments and evaluations, to determine what was needed to reinforce the building and achieve blast load requirements.

“We wanted the building to move, deflect and deform in the safest manner,” said principal engineer and structural lead supervisor Khaled El-Domiaty, Baker Risk. “It didn’t need to be a bunker. We designed it to protect the people working inside.”

Valero’s desire to complete the project prior to an upcoming plant mega-expansion created a very rigid timeframe for completion, and therefore necessitated involvement by GROUP from the beginning of design. This early involvement and the ensuing constructability process, while more costly up front, prevented construction delays later in the project.

One early change eliminated the need for new building foundations, and shaved significant cost from the project. “The initial assessment was that new building frames would need to be erected on the outside of the building,” El-Domiaty said. “We developed a workaround that allowed us do a lot of the work on the inside of the structure, without needing the extra step of building new foundations.” Additionally, the driving of piles around the building would have caused a lot of unwanted vibrations in a sensitive laboratory environment.

Within the building, GROUP replaced braces at each purlin with a heavier gauge steel, working within the ceiling to punch new holes for the braces. Small manlifts raised GROUP workers to heights of 20 feet, and ceiling grids and tiles were removed in small sections so as not to strain the building's HVAC system. Six large W8 by 58 vertical steel columns were installed at various locations inside the building, the majority of which located in the building's laboratory area.

Supporting the exterior of the building are new galvanized columns and beams. A 30-ton hydraulic crane flew the steel pieces over the building to access hard-to-reach areas. In some locations, the crew had to saw cut existing concrete pavement to install columns; or drill through the building to attach to the wall girts. All eight of the building's exterior doors were replaced with heavier gauge steel, and as an addendum to the contract, GROUP installed equipment foundation for a new bottle rack that services the building.

Uncommon Construction & Design Techniques:

GROUP was tasked with erecting and installing 30 tons of structural steel columns, steel purlins and braces both inside and outside the building. However, a lack of detailed schematics for the pre-engineered metal building necessitated that the project team make numerous design changes in the field. "We had to field measure, field fabricate and field install," Chustz said. "We worked closely with engineers to make it all work, often reconfiguring or shifting the column locations." GROUP opened up the building section by section, then relayed pertinent information to engineers so they could make design revisions. A 50- by 60-foot fabrication tent was erected in the parking lot adjacent to the building to allow GROUP to easily make modifications in the field and keep the project on schedule.

A large column to be erected in the middle of the building required that GROUP field fabricate the key structural member in two pieces, incorporating splices and connections. "We had to look at the routing and determine how we were going to transport the beam sections (using dollies) through the building without moving doors or walls," Chustz said.

Quality Control:

GROUP closely followed specified QA/QC procedures to ensure that unnecessary re-work delays did not occur. Since there were numerous revisions to site drawings, the crew painstakingly updated the drawing log and distributed revisions to the field and to fabricators. Weekly audits of the drawing logs ensured designs were consistent. The site superintendent performed routine inspections to ensure that all bolts were marked and torqued as specified. GROUP frequently communicated with the owner to minimize disruptions to Valero staff and to ensure that the interior of the facility was not damaged during construction. "We coordinated with Valero about which area we would be working in at a particular time, and they would shift employees around as needed," Chustz said. "We met daily to discuss issues."