Incorporating the "E" in EPC for Path 15 Project

Eighty-four miles of transmission line was strung for the Path 15 project.

by David Anderson

Recent articles in trade publications concerning the soon-to-be completed Path 15 Project have focused primarily on the construction aspects of one of the most significant projects of the decade. Largely unaddressed in these articles has been the very essential project engineering details of this novel engineer — procure construct (EPC) approach between private industry and the government that is deserving of recognition. You know, the "E" in EPC.

An EPC contract for the Path 15 Project was awarded to the team of Maslonka & Associates (M&A) of Mesa, AZ and Electrical Consultants, Inc. (ECI) of Billings, MT in June 2003. As a starting point, the Western Area Power Administration (Western) provided the EPC Team with basic tangent, angle and dead-end structure designs, a plan & profile composed of data from several surveys, and a raw PLS-CADDTM file as a basis for design of this 84-mile 500 kilovolt transmission line. However, without the extraordinary engineering effort by ECI staff and management support from the EPC Team, this project would not have been completed under budget and ahead of schedule. While M&A led the EPC Team as the "Prime," ECI was the instrumental engineering link throughout the course of the project and provided the common-sense engineering approach which helped to contain costs and provide the design data required to complete this Herculean effort in such a compressed time-frame. Considering the fact that Notice to Proceed (NTP) was not issued by Western until September 12, 2003, and construction activities other than project clean-up, right-of-way restoration and preparation of as-built documentation will be completed by the middle of November, 2004, the EPC Team performed an amazing job of engineering, procurement and construction for this $84 million facility in a very short 13-month time-frame.

A major factor which allowed the EPC Team to get a "jump start" was M&A's willingness to accept significant financial risk prior to NTP by initiating preliminary geotechnical work in one of the priority construction areas. ECI interviewed several geotechnical firms, selecting Kleinfelder to not only perform the

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A total of 245 lattice steel towers were built for the Path 15 project.

pre-NTP work but all of the geotechnical drilling, laboratory analysis and soil parameter development for the 144 boreholes specified by ECI for the project.

Key personnel in Kleinfelder's Pleasanton, CA Office, including Kris Johnson and Robert Ellis, P.E., worked with ECI's Project Manager and senior civil engineers, Gary Bowles, P.E. and Ed Peace, P.E., to develop the soil parameters required for design of almost 1,100 drilled pier foundations.

These foundations were required to support a total of 98 steel monopoles and 245 lattice steel towers. In all, almost 20,000 cubic yards of concrete was required to construct these drilled piers with diameters of up to 12 feet and depths of up to 48 feet. In order to effectively and efficiently prosecute the project, construction was segmented into four priority areas, A through D. The initial geotechnical data was applied to segments of the Priority "A" Construction Area and conservative foundation designs were initially developed by ECI so that M&A could procure reinforcing bar, build cages and get foundations in the ground within the first six weeks after mobilization. After receipt of the Notice to Proceed, geotechnical work was completed for the remaining priority areas and ECI optimized these preliminary foundation designs as well as those for the remaining priority areas.

M&A also took the bold step of entering into agreements with strategic suppliers to procure materials prior to receipt of NTP by Western. Without this step, the EPC Team would have lost many valuable weeks that could have resulted in a much later completion date than the EPC goal of mid-November, 2004. M&A's CEO, Martin Maslonka, along with ECI's Project Manager, David Anderson conducted these negotiations with prospective vendors and used their combined experience and insight to streamline the overall procurement process. Simply choosing the lowest bidder to provide these key components was not going to work.

Negotiation methodology was based more on quality, reliability and delivery rather than solely on overall cost. Vendors were well rewarded but in exchange, had to agree to the same contractual liquidated damages clauses as the EPC Team members and perform within the tight delivery guidelines outlined in the EPC schedule.

In addition to beginning preliminary foundation design, ECI's Project Manager assigned survey crews to stake right-of-way limits, over 120 miles of access roads, culvert installation sites and structure locations. At the height of construction activities, four survey and staking crews were assigned to the project under the direction of ECI's senior survey chief, Gary Hubbs, P.L.S.

Because of discrepancies found in the original survey data provided by Western, combined with an after-NTP directive to change minimum ground clearance from 32 feet to 35 feet, ECI's survey crews also worked with M&A personnel to collect additional survey data points, re-position PI's and re-align tangents at various locations along the transmission centerline. These revisions helped to eliminate many unnecessary small angles and optimize the structures actually used for the project. While three feet of additional clearance does not sound like much, it proved to be the primary catalyst for re-design or re-spotting of 52 individual structures. Changes to the original PLS-CADDTM files received from Western included modifications to tower body extensions, leg extensions, structure types and structure locations. In addition, several steel monopole heights were revised to account for the new ground clearance requirements and several lattice towers were actually eliminated based on analysis of new geotechnical data, inclusion of additional survey points and optimization of structure locations. Through these efforts, ECI produced a value-engineered design product that resulted in significant savings to the EPC Team and Western.

During the course of preliminary design and survey work, it was determined that the five foot incremental leg extension lengths originally provided with the lattice tower designs were not adequate for use on the project. This was primarily due to the rugged and hilly terrain encountered throughout the majority of the line route combined with the environmental constraints imposed in relation to ground disturbance at the tower sites.

In order to address this problem, ECI undertook the design of 2-1/2 foot incremental leg extensions for both the tangent and small angle structures. New leg extension designs allowed 2-1/2 foot length selections of between 5 and 35 feet. This allowed the flexibility required to properly optimize the lattice towers and gave the EPC Team much more latitude in placement of the structures. ECI's survey crews performed all of the leg extension surveys and worked with M&A personnel to determine final leg extension lengths for all lattice towers on the project.

ECI was also responsible for modifications to the family of standard lattice steel towers to allow lifting of segments assembled on the ground by helicopter to optimize construction. Using PLS TOWERTM software, our civil engineers modeled the existing structure types and determined the precise locations for new drill-holes and attachments to allow picking and aerial transport of body and bridge assemblies. In addition to project management and oversight of engineering, complete foundation design, leg extension design, surveying and staking, ECI provided the following engineering and project management services to support the EPC Team:

- Scanning and modification of several hundred existing paper drawings into AutoCAD capable digital/vector hybrid files;
- Creation of project documentation and formwork and an overall document tracking system;
- Creation of new color-coded staking sheets covering the four priority construction areas, the steel pole and conductor assemblies, and the multitude of leg and body extension combinations for the lattice towers;

- Completion and optimization of all PLS-CADDTM files;
- Structural analysis of existing Western lattice steel towers;
- Design review and approval of all tubular steel pole structures;
- Creation of project manuals for foundation construction, steel pole and lattice tower assembly/erection, and conductor stringing & sagging;
- On-site services including liaison activities related to all engineering, procurement and construction facets; and
- Preparation of as-built drawings and documentation per Western specifications.

Path 15 is located in the southern portion of Pacific Gas & Electric Company's (PG&E) service area and in the middle of the California Independent System Operator's (CAL ISO) control area. The path has been rated at 3,900 megawatts and consists of two 500 kilovolt transmission lines and four 230 kilovolt transmission lines. Through a series of system studies performed previously, it was determined that capacity through this major north-south transmission corridor was insufficient to carry the necessary electricity, especially during periods of high usage.

Path 15 is California's primary corridor for moving electricity from power plants in Southern California to consumers in the San Francisco Bay area, the area of greatest congestion on the regional grid.

Current constraints exists because three major transmission lines narrow to only two through this area of the Central Valley. For Silicon Valley, where the technology industry uses large amounts of electricity but imports 80 percent of its power from other places, boosting the reliability and capacity of the path is of major importance. In addition, lack of transmission capacity was one of the primary reasons California experienced blackouts in 2000 and 2001. Even though there were sufficient power resources in Southern California, there was no way to export them to the power hungry San Francisco Bay area.

This is the largest upgrade to California's electricity grid in nearly a decade. Completion of this project will result in an increase of the non-simultaneous south-north path rating to 5,400 megawatts. The entire project is estimated to cost just over $300 million dollars and according to the CAL ISO, will pay for itself in four short years.

The Path 15 Project is the first of its kind public-private financed project. Project participants include Western Area Power Administration, a federal agency, Pacific Gas & Electric Company, one of three California-based investor owned utilities, and Trans-Elect, Inc., the nation's largest independent transmission company.

PG&E is performing the substation upgrades as well as the 115 kilovolt and 230 kilovolt system work and will receive about 18 percent of the new transmission capacity. Western was responsible for system studies, land and real estate, as well as Owner's Representative services.

Western will retain a 10 percent share of the new system capacity. Trans-Elect has provided the remaining transmission project funding and will own the remaining 72 percent of the transmission capacity rights. Western, PG&E and Trans-Elect will turn over the operational control of their entitlement in the project to CAL ISO.

This is the first time in Western's history that an EPC approach has been employed for EHV transmission work. With completion of this highly politicized project currently scheduled for mid-November of 2004, not only is design and construction projected to be at least 10 percent under budget but also well ahead of schedule; a feat that simply could not be accomplished under a standard design-bid-build contract approach.

An EPC approach to such a major grid expansion with the aspect of private finance has received considerable attention nationwide and is being carefully watched by other utilities. This particular EPC approach with significant input and teamwork from all parties involved including M&A, ECI, Western and PG&E along with strong financial backing from Trans-Elect will ultimately become the model for relieving other transmission constraints throughout the country. NWPPA

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Electrical Consultants, Inc., played a large, integral part in the engineering of the Path 15 transmission project.