

**Final Construction Manager/General Contractor Process Evaluation
Special Experimental Project No. 14 (SEP-14)
CMGC – Construction Manager/General Contractor**

Colorado Department of Transportation Final Report for SEP (Special Experimental Project) 14
CM/GC Contract for: IM 703-348, Replacement of 2400 Medium Volt Motor Control Cabinets
January 3rd, 2013

1. Introduction

The Colorado Department of Transportation (CDOT) submits this final report under the provisions of Special Experimental Project No. 14 (SEP 14) for the use of innovative contracting practices as written in the November 9, 2009 CDOT work plan.

The Region 1 Mountain Project Management Team developed the necessary documentation, solicited proposals, and appointed a selection panel of five members to select a Construction Manager/General Contractor (CMGC) services contractor. A CMGC services contract has been executed for the Replacement of 2400 Medium Volt motor control cabinets (MCCs) located at the Eisenhower Johnson Memorial Tunnels (EJMT) in Clear Creek County, Colorado. This initial report includes a brief scope of the CMGC project, a brief summary of the procurement process, effects on the bids received, estimates of cost and time savings, lessons learned thus far, and industry reaction to the process.

2. Pre-Construction Scope

The scope of this project was to produce the final design and specifications for the replacement of the 2400v MCCs (MCCs) at the EJMT while successfully deploying the first CMGC delivery method on a CDOT project.

The design work included the selection of a replacement option from the Preliminary Report, electrical design, master control center procurement and shop drawing development, Field Office Review (FOR) plan development, and final plan development.

The CMGC services work included constructability reviews, cost savings reviews, value engineering proposals, plan set visual and written reviews, confirmation of all quantities, development of an open cost model for project development, and submittal of a GMP (Guaranteed Maximum Price) Proposal.

3. Procurement Process

During August through November 2009, CDOT evaluated different delivery systems to select a method that best fits the guidelines and project requirements for the 2400v MCC replacement. Design-Bid-Build, Design-Build, and CMGC were individually researched. Disadvantages and advantages for each method were analyzed and compared. CMGC was selected because of the requirement of CDOT control of the project site and to accelerate the design and construction schedules.

Within CDOT, support for a CMGC pilot project was strong and the unit's thorough evaluation encouraged team endorsement of the delivery method. CDOT applied for SEP 14 approval. During this process, the FHWA team asked for specific information on Colorado law regarding Innovative Contracting. The Colorado Attorney General's office was consulted and found that while not specific in allowing CMGC, statute did allow for multiple methods in innovated contracting. CDOT received procurement notice to proceed on January 25th, 2010 and developed Request for Proposal documents for a Design Consultant and a CM/GC services contractor. These documents were based on the Colorado State Buildings RFP documents and the Utah Department of Transportation CMGC program.

CDOT advertised for a CMGC services contractor and a design services consultant in parallel procurement processes to allow for both firms to begin working on the project simultaneously. Procurement began in March 2010 and selections were made in May 2010. Due to the relatively new processes, contract execution and Notice to Proceed for each firm was not successful until October 2010. This process included writing a CMGC services contract based on the Colorado State Buildings contract while modifying the document to comply with all state and CDOT procedures. Team hierarchy, construction contract language, and roles and responsibilities were challenging revisions that were required to adapt to how CDOT does business.

The design consultant process followed the typical CDOT consultant selection process with changes to support the CMGC delivery method. The CMGC selection process was based on the Colorado State Buildings process and UDOT's CMGC process. This included proposal guidelines, proposal requirements, scoring system for proposals and interviews, and the request for Cost Proposal Statement. This Cost Proposal was a proprietary item that, like a bid, would be confidential and unsealed until after the interviews were complete.

The proposals, interview, and cost proposal from the contractors were scored on the following criteria by a five person selection panel.

Proposal – Sixty Points

This document was a proposal from the Contractor with a twenty page limit that detailed the following information with point weights:

| | |
|--|---------------|
| Project Management Team/Capability of the Contractor - | Twenty points |
| Project Approach - | Ten Points |
| Project Innovations - | Ten Points |
| CMGC Design Process - | Twenty Points |

Interview – Twenty Points

The interview was an hour meeting that included a short project presentation summarizing the proposal and a question/answer session. The questions were ten questions asked to each short listed contractor.

Cost Proposal – Twenty Points

The Cost Proposal was a proprietary bid that included a proposed Preconstruction fee, Construction fee, cost of general conditions, and other reimbursable general conditions. The Preconstruction fee is the cost of completing the CMGC services. The rest of the fees and costs are part of the price of completing the construction of the project and would be rolled into the GMP during the design phase.

Due to the unique electrical work and size of the construction project, CDOT received only two proposals for both the CMGC services and the design services Request for Proposals. This presented a situation where Chief Engineer approval to proceed with less than three proposers was required and granted based on the recommendation of the Region 1 Project Team.

The selection process concluded when Sturgeon Electric was selected as the CMGC Services firm and was partnered with the concurrently selected Parsons Brinkerhoff as the Design Services for the project.

Procurement Lessons Learned:

- Dedicated Agreements and Contracting Staff to help modify, process, and fast track alternative delivery method documents would greatly increase efficiency and deployment of CMGC and other innovative contracting processes.
- CMGC services selection for horizontal projects in the future should follow UDOT's established program of including bid items with estimated quantities for price scoring along with preconstruction and construction fee bids.
- Evaluation and analysis of scoring weight percentages should be a priority going forward with a CMGC program at CDOT. Scoring and scoring directions should be revised to better evaluate horizontal construction projects with more complicated challenges.
- CDOT should establish an evaluation process to match projects with the best delivery method. This would provide documented comparisons to other delivery methods that can be independently verified.
- Standard documents should be developed by the Innovative Contracting Advisory Committee and utilized for future projects to provide a good foundation for project managers. These documents include standard templates for contracts, RFPs, scoring, and scoring directions. Feedback and pre-approval from the Agreements unit, Attorney General's Office, and the Office of the State Controller should be solicited.
- Industry participation and feedback should be solicited to improve and standardize CMGC use at CDOT. Team support and buy in is a critical factor to CMGC success.
- Communication to contractors to provide guidance on proposals and feedback on unsuccessful applications should be performed on each project.
- Revise the Cost Proposal Form to incorporate the cost of bid items into the bid and provide more detail into what constitutes the fees and reimbursable costs.

4. Preconstruction Process

The preconstruction phase for the 2400V Replacement project started in November of 2010 and was completed in August of 2012.

A project kickoff meeting was held on November 3rd, 2010 and covered partnering, the project, schedules, roles and responsibilities, communication lists, and escalation ladders for resolution of issues. This meeting was first and foremost a relationship building meeting where the team met each other and got familiar with the project. It kick started the design process based on earlier feasibility reports. After the meeting CDOT produced a session report to document the meeting and agreements. The final documents included a formal communications plan, a project organization chart, a contact list, roles and responsibilities list, a meeting schedule based on team input, a Scope Understanding and Project Development section, and a list of action items for each group would be responsible for before the first weekly team meeting. A draft report was produced and a final report distributed after the team responded with comments.

The team began with weekly project meetings to discuss scope, schedule, and budget. The scope of the project was the most critical decision. Four options for replacing the switchgear had been vetted in the preliminary electrical report completed on an earlier contract by Parsons and Hatch Mott who were not on the preconstruction project team. An immediate team decision on an option was required to move the project forward quickly so that switchgear could be procured through the long lead time procurement process and still be delivered when needed during construction. The contractor, consultant, and CDOT project members were to review the preliminary report and a decision on the options was to be made within two weeks of the kickoff meeting.

In the first meeting, the project team had a lot of discussions but no formal decisions. The design consultant favored Option 3 of moving the switchgear to a new location. The Contractor favored Option 4 that would replace the switchgear in place. The project team agreed that it would make the decision at next meeting. The next day the CDOT project manager received calls from both the contractor and consultant accusing the other side of not cooperating, listening, or collaborating. To remedy the situation, the CDOT project manager assigned each team group to put together a presentation with the advantages and disadvantages list of their preferred option to present to the project team.

After the presentations, the project team discussed each option and after looking at all of the criteria, Option 4 was overwhelmingly the choice of most of the team. The project team took into account scope, schedule, and cost. CDOT agreed with the assessment and selected Option 4. After selection of option 4, design for both the procurement (LLTP) and actual construction plans and specifications began.

Design of LLTP plans and specs took three months with three revisions and two changes to the design due to vendor availability and feedback. Design of construction plans and specifications took six months and required an extensive wiring inventory that found major risks in not replacing thirty five year old wiring from the existing switchgear to the fan deck equipment above the switchgear room. Additional funding was required to eliminate the wiring risk after the team found that the risk of wiring coming apart was high to very high. Other risks mitigated or eliminated included material delivery risk, new MCC units failing, electrical construction safety risk, existing equipment failure, work hour restrictions, overrun of construction quantities, and new electronics not responding when installed. Design was overseen by FHWA because design phase included federal funding.

Preconstruction Lessons Learned:

- Communication is an important key to a successful preconstruction phase.

- Partnering meetings throughout the process should be mediated by a professional partnering facilitator so the project team can focus on partnering.
- Cost estimators and the Independent Cost Estimator (ICE) should be involved throughout the preconstruction phase. They should meet with the team between cost model meetings and at all refinement meetings before the GMP is authorized.
- The Project Manager needs to be aware of the mood and perceptions of as many team members as possible. Tensions between team members can rise quickly and simmer beneath the surface. Conflicts and tension should be addressed immediately.
- Recognition for team members is very important in a CMGC delivery process.
- Concurrent packages can challenge a team's resources. Planning for this with structure, expectations, and schedules can be helpful.
- Actual construction superintendents for the Contractor and owner construction project staff should be at design meetings as much as possible.
- Holding all team members to requirements and responsibilities is a challenge and should be tracked monthly or weekly depending on the task.
- Risk based scheduling and estimating is recommended for any project considering CMGC.
- Meet with specialty units one on one to keep comments, reviews, and information as current as possible.

5. LLTP GMP Phase

The Long Lead Time Procurement or LLTP Phase involved the contractor, CDOT, and the consultant producing plans and specifications for long lead time items. This phase would allow CDOT to procure programmable logic controls (PLCs) and the MCCs before final construction was contracted. The LLTP Phase also carries risk to the owner if the construction GMP is not accepted. In this scenario, the owner could lose money if a low bid contractor did not use the procured items.

The LLTP phase started in December 2010 and finished in late April 2011 when a Notice to Proceed was issued to the Contractor. The project team was also working on the construction plans and specifications concurrently.

LLTP Phase Major Milestones and Events

- The project team discovered that several of the vendors interviewed in the preliminary report could not meet the required switchgear dimensions constrained by the EJMT control rooms.
- The new switchgear required turned out to be far more expensive than the preliminary feasibility report indicated because of unforeseen high risks to wiring and conduit.
- During the final acceptance, the Contractor discovered a one word error that could have cost CDOT and the project \$1.4 million dollars to correct. This error would have set the project back up to six more months if not discovered in time. With this information, CDOT changed the specification and corrected the error.
- The LLTP amendment was the first of its kind at CDOT and Office of the State Controller collaboration was required in order to get it approved.

- The LLTP GMP was accepted after negotiations with the low bid MCC supplier agreed to add liquidated damages, revisions to their proposal to fix cost errors, changes to legal language, clarification of expectations and deliverables, and correction of typos.
- The LLTP GMP proposal from low bid supplier for the programmable logic controllers was accepted into the low bid as well.
- LLTP GMP amendment was accepted in May 1st, 2011 and delivery of the switchgear was expected on October 1st, 2011.

LLTP Lessons Learned:

- All equipment for LLTP items need to be inventoried and documented so that expectations do not change during the construction phase. All documentation should be escrowed.
- The project team should double check all items and equipment for correct specifications that long lead time items are dependent on. Even one word could have major budget and schedule impacts.
- The project team should check all proposals from suppliers or vendors after multiple revisions to make sure terms or timelines have not been changed without notification. The project switchgear low bidder changed agreed times during a revision and did not tell the Contractor or CDOT.
- Liquidated damages and language concerning liquidated damages should be negotiated as soon as possible with the Contractor. The Contractor should also negotiate those terms with their subcontractors and make sure that CDOT knows the cost implications before executing the LLTP amendment.

6. Construction GMP Phase

In May 2012, CDOT authorized the GMP after construction plans and specifications were completed by the design consultant. The developed cost model broke down each bid item into cost based spreadsheets that took into account labor, equipment and materials. Two weeks were provided to the Contractor, consultant estimator, and the ICE to prepare their independent estimates. The project team opened the Contractor's first GMP proposal with FHWA present on May 23rd, 2011. The GMP was compared to the two other estimates. The GMP in comparison to the two other estimates was not within the required ten percent. The following table shows how the Contractor's first GMP proposal compares to the estimates.

| Estimate | Vendor | Total Price | % of Low Bid |
|----------|----------------------------------|----------------|--------------|
| 1 | EEMA (ICE) | \$943,598.40 | 100% |
| 2 | Engineer's Estimate (Consultant) | \$1,028,945.96 | 109% |
| 3 | Contractor GMP #1 | \$1,117,109.00 | 118% |

A GMP negotiation meeting was scheduled shortly after the proposal was opened. The ICE, contractor, consultant design estimator, FHWA, and project leadership were present to discuss assumptions and refine prices. The following issues were identified:

- The five kilovolt electrical cable identified and specified for the project was found to have been inadvertently written to designate a unique type of cable with a

polyolefin jacket. This limited the suppliers to one in the United States and elevated its price approximately two hundred and fifty percent.

- The Contractor, Engineer Estimators, and ICE were estimating two items under different assumptions on bid items that included the Wiring lump sum bid item, 3 Inch Electrical Conduit bid item, and the Removal of Electrical Equipment bid item.
- Certain suppliers were not providing quotes to the design consultants and the ICE.

Before the second GMP proposal was authorized, the project team developed the following solutions:

- The cost model was revised with correct supplier contact information and all suppliers were contacted through the Contractor. A letter was sent asking for the suppliers to provide quotes in a timely manner to the project estimators.
- The project team held a specification meeting to rewrite the cable specifications to include a requirement for a polyvinyl chloride jacket which had far more availability and price competition.
- All other assumptions were reviewed, discussed, clarified, and documented in meeting minutes. These minutes were distributed to the Contractor and all team members responsible for estimating.

The second GMP was authorized and the Contractor's second GMP proposal was opened on June 27th, 2011. The following table shows how the Contractor's second GMP proposal compares to the estimates.

| Construction GMP Proposal #2 | | | |
|------------------------------|--|--------------------|---------------------|
| <i>Estimate</i> | <i>Vendor</i> | <i>Total Price</i> | <i>% of Low Bid</i> |
| 1 | Contractor | \$1,066,882.00 | 100% |
| 2 | EEMA (ICE) | \$1,094,409.66 | 103% |
| 3 | Engineer's Estimate (Design Consultant) | \$1,115,022.32 | 105% |

The Contractor's second GMP proposal was 5% under the Engineer's Estimate and 3% under the independent cost estimate. The second GMP proposal was accepted on July 26th, 2011. The contract process for the construction phase was complete in two days and a Notice to Proceed was issued on July 28th, 2011.

7. Construction Phase

The preconstruction meeting was held on August 2nd, 2011 and construction started on August 8th, 2011. Construction on the wiring, conduit, and all other construction items besides the Programmable Logic Controllers and MCCs were first to be constructed as the construction team waited for the delivery of long lead time items.

The Programmable Logic Controllers arrived on September 15, 2011 and installation was completed by November 30, 2011.

The 2400V MCCs arrived on November 15, 2011 and several cabinets were incomplete or needed modification. The construction team requested additional supplies from the supplier and the last motor control cabinet was completed on December 1, 2011. The

MCCs also came in six weeks late. The Contractor enforced the liquidated damages and worked with the supplier to correct all problems with the materials.

Final construction was complete on January 18, 2012 and the project was accepted by CDOT on April 11, 2012.

Construction Lessons Learned:

- After construction starts the project proceeds very similar to a traditional CDOT design - bid – build project.
- What CMGC helped with in construction was in the overall scheduling and procurement. The contractor did not have to bid the job with only three weeks of looking at the plans. He had time to develop a better schedule of material delivery and personnel.

8. Cost and Time Savings

The project leadership and project manager for this project was changed before the preconstruction phase was complete. The scoping budget was supplemented after significant risks to the MCCs were addressed. After these risks were addressed the overall budget for this project was \$3,527,857.00 million dollars.

| Project Cost Categories | Estimated | Expensed | Cost Savings |
|---|-----------------|-----------------|--------------|
| Design and Feasibility | \$ 227,557.00 | \$ 227,557.00 | 0% |
| Design Consultant | \$ 360,000.00 | \$ 295,000.00 | 18% |
| CMGC Services | \$ 84,090.00 | \$ 84,090.00 | 0% |
| LTP GMP (Material Procurement) | \$ 1,350,000.00 | \$ 1,350,000.00 | 0% |
| Construction GMP and F/A (Contract Amount) | \$ 1,506,210.00 | \$ 1,056,210.00 | 30% |
| | | | |
| Overall Project | \$ 3,527,857.00 | \$ 3,012,857.00 | 15% |

The original project design schedule was twelve months. The project team completed the design in nine months finishing the preconstruction three months ahead of schedule. The original project construction schedule was ten months with long lead time procurement and construction through a design-bid build delivery. The construction team finished the project in five months finishing the construction five months ahead of schedule utilizing the long lead time procurement process before construction began.

9. Meeting Project Goals

An analysis of the major project goals was completed after final construction was accepted in April 2012.

1. To produce the final design and specifications for the replacement of the 2400v MCCs (MCC's) at the EJMT.
 - The project team produced the final design and specifications for an LLTP phase and a construction phase for the replacement of the 2400v MCCs (MCC's) at the

EJMT. All of the plan set and specifications were utilized during the design. The project team successfully completed this project goal.

2. To replace the 2400 medium volt motor control centers (MCC).

- The project successfully replaced the 2400 medium volt MCCs. In addition upgraded the mechanical relays to programmable logic controls and successfully replaced all the thirty five year old wiring from the new MCCs to the fan deck on both sides of the tunnels. The project team successfully completed this project goal.

3. To facilitate and foster collaboration, communication, and partnership with all members of the project team.

- The project team met weekly and biweekly to solve issues, foster collaboration, and practiced partnership in attaining goals and executing the first CDOT CMGC. The project team successfully completed this project goal.

4. Encourage Innovation and value engineering.

- The project team was able to integrate the following innovations and value engineering that saved the project money:
 - a. Contractor proposed complete wiring investigation to determine quality and risks to old wiring and power cables.
 - b. Utilized old unused conduit for new wiring to cut down risk of pulling new wiring against older wiring. This reduced costs and schedule time during construction.
 - c. Introduced new programmable logic controls to replace outdated and irreplaceable mechanical relays.
 - d. Conducted RFI Task Group meetings during construction to resolve issues and find solutions.
 - e. Created a schedule that enabled more opportunities for cabinet downtimes to speed up the installation of the construction project.

The project team successfully completed this project goal.

5. Accelerate Delivery of the Design and Construction Schedules.

- The original project design schedule was twelve months. The project team completed the design in nine months finishing the preconstruction three months ahead of schedule. The original project construction schedule was ten months with long lead time procurement and construction through a design-bid build delivery. The construction team finished the project in five months finishing the construction five months ahead of schedule utilizing the long lead time procurement process before construction began. The project team successfully completed this project goal.

6. Zero Change Orders on CMGC Project.

- No changes orders were issued or executed on the 2400V MCC Replacement project. The project team successfully completed this project goal.

7. To successful deploy the CMGC method on a CDOT project.

- The project team successfully deployed the CMGC/method on the 2400V MCC replacement project. The project team successfully completed this project goal.

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