HEAVY MOVABLE STRUCTURES, INC.

EIGHTH BIENNIAL SYMPOSIUM

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Grosvenor Resort
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"Electrical and Mechanical Rehabilitation of the Conrail Calumet River Vertical Lift Bridge"

by Tim Mander
Aldridge Electric, Inc.

Heavy Moveable Structures
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Orlando, FL

"CR" Bridge

Electrical and Mechanical Rehabilitation
Consolidated Rail Corporation
Vertical Lift Bridge
Calumet River, Chicago, IL

By Tim Mander
Aldridge Electric, Inc.
Libertyville, IL

Owner / Operator:	Consolidated Rail Corporation Philadelphia, PA
Prime Contractor:	Aldridge Electric, Inc. Libertyville, IL
Consulting Engineers:	Hardesty & Hanover New York, NY

The purpose of this contract...

...was to rehabilitate an 88 year old skewed span, vertical lift, rail bridge. Nicknamed "CR" bridge; it is the only bridge remaining in operation, from a group of 4 bridges built in 1912, at this crossing of the Calumet River, in Chicago, Illinois.

Contract Schedule

Pre-Shutdown Activities:	April 1, 1998 through January 31, 1999
River Traffic Outage:	February 1, through February 23, 1999
Punchlist, Closeout:	February 24 through March 31, 1999

This was a very aggressive schedule, considering the sum total and variety of work required by this contract, combined with the natural conditions of a busy bridge. A bitterly cold and snowy, early winter threatened the scheduled completion of essential structural modifications and other exterior activities. However, human desire overcame the elements and we were blessed with a warm, dry February.

The bridge was successfully operated on February 22, 1999.

Contract Restraints

- *Maintain rail operations throughout the project duration.*

  This requirement was especially difficult since this is the only operating bridge at this crossing of the Calumet River. In times past, there were up to (5) bridges operating at this location. Close coordination with Conrail's on site representative allowed brief, periodic track outages to move equipment on and off the bridge.

  Longer track outages were needed when additional weight was added to the counterweights at the top of each tower.

- *Maintain waterway and bridge operations at all times, through January 31, 1999.*

  Cranes were set on work barges, which were placed on both sides of the bridge to stage and hoist equipment and materials to and from the bridge. The barges had to be moveable within a two-hour period to allow free flow of river traffic.

- *Remove and replace all bridge span operating equipment between February 1, 1999 and February 24, 1999.*

  This all or nothing proposition required months of planning to ensure the success of the project. Once the ropes were cut, there was no turning back. Each relevant activity was identified prior to the shutdown and then reviewed daily for progress during the shutdown. Just-in-time delivery of structural supports and machined equipment left no margin for error and caused a few sleepless nights along the way.

Electrical Elements of the Project

Aldridge Electric self performed replacement of the electrical distribution system, consisting of primary metering equipment, an underground 3760 volt primary feeder, 500 KVA service transformer, 350 KW standby diesel generator, automatic transfer switch, and associated distribution equipment.

Aldridge Electric installed a well designed bridge operating system, manufactured and integrated by Panatrol Corporation, consisting of (2) Flux Vector motor drive controllers, (2) 250 HP drive motors, and a custom built PLC. The bridge is designed for one motor operation. For emergency operations, a 25 HP auxiliary drive motor with gear reduction was installed and coupled to the drive train with a manually operated clutch. Normal and emergency bridge operations are accomplished from a custom built operating console. A new track signal control panel communicates bridge status, from bridge operator to railroad communication and signal personnel, for fail safe operation of the bridge.

After fabrication, all control equipment was staged and temporarily wired at Panatrol Corporation for a full control system test. This was done to ensure we would have no unforeseen problems with the equipment or control logic once the equipment was on site. Once completed, the motor drive equipment was transported to a facility in Milwaukee for a full load test of the motors, motor controllers and associated equipment. Upon successful completion of the test, the equipment was delivered to the job site and immediately installed.

Multi-conductor, "droop cables" were installed to provide power and control wiring to the bridge span. The cables are terminated in termination cabinets, which are attached to custom fabricated platforms, mounted at the middle point of each tower and at corresponding corners of the bridge span. The cables are attached with flexible cable grips and laid over a cable deflector to keep the cables out of the waterway during operation of the bridge.

Miscellaneous electrical work performed as part of this contract included replacement of bridge span lighting fixtures, convenience receptacles and control devices on the tower structures and bridge span. Machinery room electrical equipment was completely replaced as well.

Structural Elements of the Project

Aldridge Electric subcontracted construction of a new bridge operator's building to Illinois Constructor's Corporation. The building contains electrical distribution equipment, motor drive controllers, and bridge control and operating equipment. The building also serves as a work area for a full time bridge operator. The building sits on two pre-existing piers, which previously served as supports for a neighboring bridge.

Illinois Constructor's Corporation changed the design of the operator's building from structural steel to structural concrete, electing to use cast-in-place concrete columns and pre-cast concrete floor support beams. The walls, roof and interior finishes remained unchanged.

A structural steel stair and walkway provide access to the building from the support piers and bridge span. A wood timber fender system was added to the side of the piers to protect the building from passing vessels.

Structural steel platforms, installed on each bridge structure, provide access to the uphaul and downhaul operating rope takeups and droop cable support platforms. Structural steel platforms were also installed on the bridge span to provide access to the secondary deflector sheaves and droop cable support platforms. In addition, modifications were made to the existing grating around the operating drums and machinery areas.

Attachment of structural supports to the structure by welding was prohibited. The original riveted connections were replaced, where required, by bolted connections. Additional holes were drilled through the structure, and reamed as required, to provide connection points for each new structural component. To expedite delivery, many structural components were field drilled due to the difficult or impractical task of field measuring connection locations prior to shipment.

A local steel fabricator was contracted to final design, fabricate and deliver all structural components for the project.

Mechanical Elements of the Project

Rehabilitation of the bridge operating machinery was by far the most challenging aspect of this project. Aldridge Electric subcontracted procurement, coordination and installation of machinery, machinery supports and all related items to Illinois Constructor's Corporation.

Prior to removal or installation of equipment on the bridge span, the balance condition of the bridge was calculated using "strain gage" testing procedures. The weight of the span was increased by this project and equal weight was added to the main counterweights during the shutdown. A post construction strain gage test was conducted and found the bridge to be span heavy by an acceptable amount of 34,000 pounds.

Auxiliary balance chains (12) were found to have worn link pins. The chains were detached from the bridge and hoisted down to the ground, where the pins were replaced. An extra chain was found on site, reworked and rotated with the first chain removed, to expedite the process and maintain balance at all times.

Every effort was made to reduce the amount of work to be done in January and February. Items were prioritized and expedited based on where they were located on the bridge and if we could install them prior to the shutdown. Much of the work on the structures and span was related to the operating rope supports and tensioners. Sheave assemblies were pre-assembled and hoisted onto the span in one piece. Supports for the uphaul rope deflectors and take up supports were installed at the top of each tower. Reinforcement of the structure and span for connection of new machinery supports was also completed prior to the shutdown.

The operating drums presented a number of challenges. Floating shafts, between the drum shaft and drive train, were removed, re-machined and returned to the job in a matter of days. The drums themselves are so large, only one source could be found to make them. The drum support bases required extensive reinforcement of the span and all of the drum work had to be done during the shutdown. As soon as the drums were set in place and made ready, the process of reeving (4) 1" pre-stressed ropes per drum was begun.

In the machinery room, only the open gearing would remain. All other equipment was removed, weighed, and scraped. The pinion shaft was promptly removed and sent out for re-machining. Parts of the floor were removed to gain access to the floor beams, which were then reinforced to support the motor and gear box support structures. Everything was hoisted from the barges through holes cut into of the sides of the room. The old operator's coop was cut apart and reduced to become a simple platform below the machinery room.

Once the pinion shaft was returned and the supports were in place, the gear reducers, brakes and motors were set, coupled and aligned. Prior to the shutdown, the major components were pre-fitted at Illinois Constructor's shop to ensure that all of the various parts were correct and on hand. Other than the electric clutch for the auxiliary motor, which subsequently was changed to a manual clutch coupling, everything went together as it was designed.

Addressing the Safety Issue

A brief safety meeting was held each morning with everyone on the job to discuss the day's activities and reinforce the importance of safety on the project. The objective was to create a sense of importance about safety. Everyone was reminded that at any given time, one missed step could cause a serious injury to themselves or a fellow worker. One moment of distraction by one person could spell disaster for many.

To ensure a safe work environment, safety department representatives from the owner, contractors, and their insurance companies, frequently conducted safety inspections. A hazard analysis of all major activities was completed and used to evaluate specific safety requirements and procedures. Everyone on site understood their responsibility for safety and was encouraged to report unsafe conditions.

The owner provided full time flagmen to control access to the structure, warn the construction crew of approaching trains, and report any unsafe conditions. By constantly monitoring rail traffic and worker access to the bridge, workers were able to walk on and off the structure, move and stage equipment, and perform construction tasks, without interfering with rail traffic or risking their safety.

There was no property damage and there were no injuries for the duration of the project.

As always, it is the human element that makes a project successful.

Many thanks to Ken Aldridge, Lee Bennett, Don Chesny, Dean Chrones, Mike Connolly, Ron Davis, John Gimblette, Michael Goich, Vandana Gogate, Steve Harlacker, Jerry Johnston, Brad Kopping, Mark Lustig, Rob Moses, Abbas Pourbohloul, Jim Quinlan, Roy Rasmussen, James Richter, Steve Rivi, Pete Roody, Bob Schless, Doug Setmeyer, Paul Skelton, Terry Southard, Chris Svara, Gerry Weitzel, Debbie Wolff, Charles Yordy, and Frank Zetthe.

Thank you all for all you did to make it happen.