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Protecting New Orleans - Fast Track Design Build to Respond to Natural Disaster

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PROTECTING NEW ORLEANS - FAST-TRACK DESIGN-BUILD TO RESPOND TO NATURAL DISASTER

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ABSTRACT

The design-build project increased the stormwater pumping capacity by 7,500 cubic feet per second (cfs) at the two major canals. The scale of the project was massive and the pumping systems were online within 7 months of contract award. The project included eight new pumping systems at the London Avenue Canal site and 25 new pumping systems at the 17th Street Canal site. This paper presents the design-build approach implemented by WESTON to increase the stormwater pumping capacity, describes how project challenges were overcome to maintain the aggressive schedule, presents the factors that led to the success of this project, and addresses the possibility of future extreme weather events.

KEYWORDS: design-build, storm surge, hurricane protection, pumping stations, flooding.

INTRODUCTION

On August 29, 2005, Hurricane Katrina battered the Gulf Coast and made landfall near Buras, Louisiana. When Hurricane Katrina made landfall it was a strong Category 3 storm, with 125-mph winds and dumping as much as 15 inches of rain in some parts of the state. As a result of the rain and storm surge, the level of Lake Pontchartrain rose and caused significant flooding along the lake's northeastern shore. Katrina's storm surge also led to over 50 breaches in the levee system protecting metropolitan New Orleans, and the Mississippi River Gulf Outlet breached in several places, flooding much of east New Orleans. The major levee breaches in the city included the 17th Street Canal and the London Avenue Canal, which left 75% of the city flooded and caused billions of dollars in damages. In many cases the levee system catastrophically failed after the storm had moved inland.

The Hurricane Protection Office (HPO), established by the U.S. Army Corps of Engineers, New Orleans District, is responsible for the long-term projects to restore, complete, and improve Louisiana's hurricane protection systems. Integral to these systems are the Temporary Outfall Canal Pump Stations located at the city's three major canals—17th Street, London Avenue, and Orleans Canals.

METHODOLOGY

Phase I

Immediately following Hurricane Katrina, the HPO commenced design and construction for the first phase of the Temporary Outfall Canal Pump Stations project at the three major canals. The Phase I work included construction of an automatic gate system at the end of the canals where they flow into Lake Pontchartrain and vertical pumping systems to pump the canal flow around the gates and into the lake. During normal storm events, the stormwater collected in the City of New Orleans is pumped into the canals and flows by gravity into Lake Pontchartrain. With the

threat of a major storm or hurricane, the gates, which are designed to prevent a storm surge from Lake Pontchartrain from entering the canals, will be closed. The pumps will then be activated to direct water flowing in the canals around the gated structures and into the lake.

Initially at each of the three major canals, 12 hydraulic pump systems were installed. Upon further analysis, the HPO determined additional capacity was required at the 17th Street Canal site and installed six additional units. As the Phase I work progressed, the HPO continued to study these systems and determined that the Phase I pumping capacities at the 17th Street Canal and London Avenue Canal sites were insufficient to maintain or meet the demands of the city's stormwater pumping capacity. The HPO decided that the additional pumping capacity would be implemented under a Phase II contract.

Phase II

On January 31, 2007, Weston Solutions, Inc., was awarded a design-build contract by the U.S. Army Corps of Engineers to increase the existing temporary pumping capacity at the 17th Street and London Avenue Outfall Canals within a compressed 7-month schedule. Under this accelerated schedule, the pumping systems would be operational by the height of the 2007 hurricane season, and completing the project on time would be a significant milestone in New Orleans hurricane protection efforts.

The scale of this project was massive. This design-build project increased the stormwater pumping capacity by 7,500 cubic feet per second (cfs) at two of the major canals. To put this into perspective, 7,500 cfs is equivalent to 3,366,234 gallons per minute (gpm), or 4,847 million gallons per day (mgd). To further put this into perspective, 7,500 cfs is enough capacity to match the average flow of water for eight major river systems in the United States, including that of the Delaware River.

A total of 33 pumping systems were installed at the canals.

The major system components installed at the London Avenue Canal consisted of the following:

- Eight axial flow pump assemblies consisting of diesel engine, right-angle gear drive, and formed suction intake (FSI); four pump assemblies were located on both sides of the canal; the total capacity of the eight pumps is approximately 2,400 cfs.
- Pile-supported pump platform including a reinforced concrete deck and structural steel intake sumps for each pump assembly.
- Four 7-foot-diameter discharge headers extending from the pump discharge through the existing cofferdam and discharging into Lake Pontchartrain; the headers were arranged for two pumps discharging into a single header.
- Diesel fuel storage and delivery system automatically controlled to supply fuel to the pump engine belly tanks and the emergency generator day tanks; a fuel system was located on both sides of the canal.

The major system components installed at the 17th Street Canal site consisted of the following:

- Eleven axial flow pump assemblies consisting of diesel engine, right-angle gear drive, and FSI; all 11 pump assemblies were located on the east side of the canal; the total capacity of the 11 pumps is approximately 3,500 cfs.
- Pile-supported pump platform including a reinforced concrete deck and structural steel intake sumps for each pump assembly.
- Three 9-foot-diameter discharge headers extending from the pump discharge through the existing cofferdam and discharging into Lake Pontchartrain; the headers were arranged for two pumps discharging into a single header.
- Diesel fuel storage and delivery system automatically controlled to supply fuel to the pump engine belly tanks and the emergency generator day tanks.
- A temporary 1,600-cfs pumping system consisting of 14 hydraulic-operated pump assemblies and a fuel storage and supply system.

The axial flow pumps, diesel engines, right-angle gear drives, and the FSI equipment were purchased and supplied by the Government under a separate contract. The separate equipment purchase contract was executed in December 2006 to ensure the fabrication and delivery schedule supported the overall construction schedule.

Challenges

The project presented many challenges that required quick resolution to meet the overall goal of the project. In addition to the accelerated schedule, the team needed to increase portable pumping capacity from 800 cfs to 1,600 cfs, handle design modifications resulting from canal hydraulic modeling, and handle difficulties posed by constricted work sites, geotechnical issues, pump platform vibration analysis, and construction safety issues, including the safety of workers working in the heat of the Louisiana summer.

Portable Pump Capacity

The project scope of work included the procurement, installation, and startup of 800 cfs of “portable” pumping capacity at the 17th Street Canal location. This capacity was termed “portable” because it was envisioned that it would be abandoned after the installation and startup of the 11 axial flow pumps. Immediately after contract award, the portable pumping capacity was increased to 1,200 cfs, and 3 weeks later, the capacity was finalized at 1,600 cfs. The “portable” pumping system was required to be fully operational by June 1, 2007, to coincide with the start of the hurricane season.

WESTON immediately assembled a separate design team to work on this component of the project. The equipment specification was developed and several pump manufacturers were evaluated. A lease-to-purchase procurement was developed to provide the HPO with the option

to purchase the equipment and leave it in place for additional pumping capacity. The delivery schedule was the greatest challenge because all equipment needed to be on-site with sufficient time allowed for the installation and startup of the system. The size of the pump units was based on an evaluation of equipment in stock or readily available, the number of units required meeting the overall capacity, space requirements, and equipment performance and quality.

The pumping systems were purchased from Moving Water Industries (MWI), which was also the supplier of the Phase I equipment. Fourteen pump systems were procured, each rated for approximately 120 cfs. The pump was a 42-inch hydraulically driven axial flow submersible with a 500-hp diesel engine drive.

Neither side of the canal allowed sufficient space for the equipment and discharge piping. After evaluating several options, it was decided to install the units on the gate structure built during Phase I. This location also had specific restrictions, including providing access for a crane and not obstructing the normal flow in the canal. To overcome these restrictions, the engines were mounted off to one side of the platform to ensure adequate access for a crane with the outriggers extended, and the pumps were mounted in the canal in line with the existing piles. The discharge piping, 42-inch, was routed in line with the piles and under the platform. All arrangement requirements were met and the system was operational on June 1, 2007. The HPO later decided to exercise the purchase option for this system. Therefore, all equipment was left in place and the additional 1,600 cfs was added to the overall system capacity.

Hydraulic Modeling

During the design and construction of the Phase I system, the HPO, in conjunction with the U.S. Army Engineer Research and Development Center (ERDC) located in Vicksburg, Mississippi, performed a modeling study of the 17th Street Canal hydraulic conditions. The purpose of the study was to simulate maximum flow conditions in the canal with regard to the performance of the pumping systems. The existing 20 pumps installed in Phase I as well as the 11 pumps installed in Phase II were included in the model. ERDC studied the effects of vortices and velocity distribution at the pump inlet and various methods to improve sump conditions for the new pumps. The results of the modeling were completed and made available immediately after contract award. The modeling results required design modifications to the pump platform structures, specifically the pump sump area. The following design features were implemented to support the modeling results:

- Design and install divider walls between each pump intake and a breast wall flush with the face of the FSI. This design created separate sumps for each pump intake and eliminated vortices forming at the face of the FSI.
- Design and install an inlet grate with 50% blockage located at the upstream end of the divider walls or sump inlet. The grate dimensions were 7.5 inches wide and 24 inches deep, with 7.5 inches between members. The inlet grate effectively reduced the lateral velocity across the face of the FSI.

- A sheet pile deflector wall was installed at the upstream end of each pump platform. The deflector wall diverted the canal flow from the sides of the pump platform into the center of the canal.

Surface vortices, swirl, and submerged vortices can all lead to pump vibration, cavitation, reduced efficiency, and poor pump performance. By implementing the design enhancements described above, along with the installation of the FSI, these items were either eliminated or within the acceptable limits published in the Hydraulic Institute Standards.

To incorporate these requirements into the system, a substantial redesign of the pump platform structures was required. The pile support system for each pump platform required redesign, which impacted the schedule but ultimately resulted in a cost savings to the client. At the 17th Street Canal, the original design included twenty-two 30-inch and eighty-eight 14-inch-diameter-pipe piles; the final design increased the quantity of 30-inch-pipe piles to 36, added twelve 24-inch piles, and eliminated all 14-inch piles. This resulted in an overall decrease in the number of piles (62), and, based on the final tip elevations, a decrease of over 3,700 linear feet of pile. Similar savings were experienced at the London Avenue Canal. The original design included sixty 24-inch-diameter-pipe piles and one-hundred-and-forty 24-inch “H” piles; the final design increased the quantity of 24-inch piles to 70, and eliminated all 24-inch “H” piles. This resulted in an overall decrease in the number of piles (130), and, based on the final tip elevations, a decrease of over 9,000 linear feet of pile.

The pump platform lower sump area was also redesigned from a concrete structure to a structural steel arrangement, and it needed to be widened to accommodate the sump requirements. The proposed design consisted of a reinforced concrete sump floor, side walls, and back wall. The modified arrangement consisted of structural steel shapes and plate for the sump floor, breast wall, and side walls. The FSI was also supported on steel shapes and plate and the side walls and rear wall were eliminated in the FSI area. The structural steel arrangement provided several advantages, including the following:

- The walls and floors were able to be supported off of the pile system, eliminating the piles to support the sump floor as mentioned above.
- Certain elements of the structure were able to be prefabricated off-site in a controlled environment, which saved time and cost.
- The contractor was especially proficient in structural steel and welding techniques, which increased quality.

Constricted Work Sites

The work sites at both the 17th Street Canal and London Avenue Canal locations were very constricted. The construction schedule needed to be prepared and constantly updated so different work elements could be completed simultaneously without interference with each other. Because of the tight work sites, it was required that construction equipment such as cranes, man lifts, etc.,

be located in and along the canal. Flexi floats were used so that the cranes could be placed in the canal for the pump platform construction. The levees also needed to be sufficiently stabilized to support the heavy equipment and load working adjacent to the canal.

Each site lacked sufficient space for an equipment laydown area. The pumps, engines, gear drives, and FSIs were stored off-site at a former Naval Reserve Training Center and transported to each site on the day of installation. This resulted in additional coordination procedures as well as security measures at the remote site. At the London Avenue site, the pumping equipment needed to be handled twice for installation. The equipment was transported on flatbeds and was parked on a bridge upstream of the work site. The equipment was then offloaded onto a flexi float and guided down the canal to the site, where it was then lifted into position.

Similar obstacles were encountered at the 17th Street Canal site, which was even more constricted than the London Avenue site. A temporary pile-supported crane platform needed to be built so that the crane could be located in the proper position to not only construct the pump platform but also lift the pumping equipment into place.

The construction sequence at the 17th Street site was managed so that multiple systems could be constructed simultaneously. The site was broken down into five areas and work was able to proceed simultaneously in at least three areas. The installation of the 108-inch-diameter pile-supported discharge headers started at the north end of the site and worked its way south toward the pump platform. The construction and installation of the pump platform and equipment started at the north end of the platform (which was the south end of the discharge headers) and proceeded south. As the pump platform and equipment installation progressed, the temporary crane platform was able to be dismantled. This was significant because it allowed the discharge header to be installed and connected to the pumps.

The lack of laydown area also impacted the schedule. The 108-inch-diameter discharge pipe for the 17th Street site was fabricated in Texas. The site lacked sufficient space to store this material, so multiple shipments were made to coordinate with construction progress. Severe flooding in Texas during this time delayed delivery of this material for several weeks, requiring the temporary closure of the eastbound lanes of the adjacent bridge to allow for equipment and material temporary laydown.

Geotechnical Issues

Challenging and sophisticated geotechnical engineering work effort was associated with the final design and construction of the structures at both project sites. This was primarily a result of the less-than-ideal geology of the near-surface soil conditions that underlie the two project sites. In particular, the surficial geology of the greater New Orleans area generally consists of layers of variable alluvial sediments created through the depositional action of the Mississippi River as it flows through its delta to a final discharge within the Gulf of Mexico. Depositional action associated with the lower flow velocities that occur near the mouth of a river typically results in the accumulation of thick, very soft and loose sediments beneath and adjacent to the river. This typical geologic behavior is consistent with the encountered subsurface conditions at both project sites. In particular, both sites were underlain by both very soft and weak, and therefore highly compressible, fine-grained cohesive soil (i.e., silt and clay) strata, and very loose, low shear strength, coarser grained, cohesionless soil (i.e., silty sand and sand) strata. In general, these low

shear strength/highly compressible interbedded soil layers range in combined thickness from 43 to 57 feet at the London Avenue site, and 65 to 73 feet at the 17th Street site. Proper foundation support of heavy project structures in this subsurface environment requires the use of pile foundations that extend through the entire thickness of these weak compressible soil layers to an end-bearing condition within deeper, more competent, higher shear strength soils to ensure that the foundations can adequately support the applied structural loadings while undergoing insignificant and structurally tolerable settlements.

The project structures that required final geotechnical design and construction may generally be included within two categories. The first includes those structures that required pile foundation support to ensure proper operational performance. These include the three elevated pump stations located within the footprints of the London Avenue and 17th Street Canals, the on-land elevated fuel storage tank platforms at both sites, and the “pipe bents” that structurally support the large-diameter pump discharge pipelines at both sites (i.e., 84-inch outside diameter (OD) at London Avenue; 108-inch OD at 17th Street). All of these structures were deep foundation supported using driven piles. Both 24-inch OD open steel pipe piles and steel “H” piles were used for this purpose at the London Avenue site. Open steel pipe piles (14-inch, 24-inch, and 30-inch OD) were used for this purpose at the London Avenue site.

The second category includes continuous lines of cantilevered steel sheet piling that function as either retaining structures in areas of the site in which the final grading plans required abrupt and significant grade changes, or as deflector (i.e., “skirt”) walls installed within the canal footprints which will, in the event of future hurricanes, direct flowing canal water to a position beneath the elevated pump platforms, where it will be pumped to the large-diameter discharge pipelines. Consistent with the thick, weak, low shear strength condition of the surficial alluvial deposits as discussed above, these cantilevered sheet piling structures generally required significant embedment to ensure proper performance (e.g., maintaining long-term plumbness) under the design lateral loadings (i.e., unbalanced lateral earth pressures in the case of retaining structures and hurricane-induced wave forces in the case of the deflector walls).

Field dynamic pile load tests were also completed at both project sites for the purpose of verifying the specified allowable compressive loadings used to final design the various pile-supported project structures. A pile-driving analyzer (PDA) was used for this purpose to complete testing of four steel “H” piles at the London Avenue site and four 14-inch-diameter open steel pipe piles at the 17th Street site. Very good to excellent correlation was achieved between the allowable pile loadings for these two pile types as estimated using pile static analysis computational procedures, and those values measured in the field by the PDA testing equipment as the eight piles were being driven at tip elevations approaching the minimum specified tip elevation consistent with the static analysis results.

An interesting geotechnical issue developed at the 17th Street site regarding the construction of the elevated pump platform and the mechanical equipment located atop the platform. To complete this construction, it was first necessary to vertically drive steel sheet piling around the perimeter of the pump platform pile system to act as a temporary retaining structure (TRS). Following dewatering of the TRS, construction of the pump platform and installation of the equipment was to be completed in a routine manner. However, subsequent construction activities

in which very heavy pump platform structures and equipment would require placement using a 300-ton crane were determined by analysis to overstress one or more of the cofferdam's structural components as a result of the surcharge loading created by the crane operating atop the ground surface immediately adjacent to the cofferdam. It was therefore necessary to design and construct a temporary structural crane platform at a slightly elevated position over the footprint of the area in which the crane would need to track to structurally support the crane before these heavy lifts could be permitted. This platform was deep foundation supported by a series of open pipe piles that were driven to depths greater than that of the cofferdam's sheet piling. In this manner, the compressive loadings of the 300-ton crane and its heavy lifts would be transferred by the pipe piles to great depth, thereby preventing lateral surcharge loadings from the loaded crane from negatively impacting the cofferdam. Following completion of the pump platform structure and the installation of its mechanical equipment, the crane platform was dismantled. The crane platform pipe piles were then used in combination with additional open pipe piles driven subsequent to the removal of the platform to support the pipe bents, which in turn support the 108-inch pump discharge pipelines.

Schedule

Probably the most significant challenge for the entire project was meeting the aggressive schedule. The contract was awarded to WESTON on January 31, 2006. The first key deadline was to have the 1,600-cfs system operational by June 1. The second key deadline was to have the 11 pumping systems at 17th Street Canal and the eight pumping systems at London Avenue Canal operational by August 15—the height of hurricane season and exactly 200 days from the project start date. The entire team was motivated in knowing that successfully completing the pumping station projects on time would be a significant milestone in the New Orleans hurricane protection efforts.

The engineering staff completed the design in a sequence that matched the critical path for construction and material procurement. In some cases, such as pipe piles and “H” piles, material procurement was approved before the completion of the specific design elements. Although there was some risk in this procedure, the procurement was only approved after the engineer had properly evaluated the pile size and committed designing around the selection. At times additional material would have to be ordered to conform to the final design; however, pre-procurement gave the subcontractors a head start on the construction of the critical structures. The engineers also reduced shop drawing review turnaround time from 4 days to 24 hours. Simultaneous reviews were conducted by the design engineer, QA/QC staff, and the client. This procedure required close coordination with all reviewers and provided subcontractors with expedited response time.

The construction crews worked long hours. When the construction activities reached full strength, the 17th Street site worked 24/7 and the London Avenue site worked 12-hour days, 7 days a week. WESTON met with the subcontractors daily to discuss and improve construction deadlines; the construction schedules were updated weekly.

Improvement to the schedule was recognized in the sequencing and methods employed by the subcontractors. For example, at the 17th Street site, a TRS was built in the canal so that construction of the pump platform could be completed in the dry. The TRS was built in three

sections; when one area of pile driving was completed, the TRS was constructed and the section was dewatered. Once the TRS section was dewatered, the construction of the pump platform was able to commence in this section while the other pump platform piles and TRS sections were being installed. This process was repeated for each section.

The steel framing structure for the 17th Street Canal pump platform was fabricated off-site in a controlled environment. Off-site fabrication was faster compared to on-site construction and allowed higher quality. When the fabrication was complete, the structure was broken down into several sections so installation could coincide with the completion of the TRS sections.

Many of the steel fabrications were assembled off-site. The pipe piles were welded off-site then barged and/or trucked in, which saved pile-driving time. Also, like the pump platform structure, the temporary crane platform structure was fabricated off-site in sections, which saved field-erection time.

Another item that saved significant time was substituting epoxy grout for concrete grout. The subcontractor recommended an epoxy-based, pourable compound called Chockfast to grout in the diesel engines and pump base plate. This product was easy to use and quick to apply, but its biggest advantage was its favorable cure time. Based on the specific product and temperature, we were able to realize cure times in 24 hours or less.

Lastly, another example of how the aggressive schedule was met was the overall startup process. WESTON assigned a separate startup team to the project and developed a comprehensive startup plan well in advance of the startup process. The startup team was supported by the equipment manufacturers and subcontractors. Key to the startup process was starting up various subsystems as they became available. As the pumps and engines were put in place, the checkout and startup process began; 55-gallon drums were used to fill the diesel engines because the diesel fuel system had not yet been completed.

RESULTS

A summary of the key events and timeline of Phases I and II of this project, and results, is as follows:

- 2005 – Hurricane Katrina Landfall on August 29
- 2006 – RFI issued on October 17
- 2007 – Contract awarded on January 31
 - ✓ Partnering meeting 28 February
 - ✓ Begin 17th Street piling 09 March
 - ✓ Begin London Avenue (LA) piling 11 March
 - ✓ Initial stakeholders meeting 20 March
 - ✓ Complete fabrication of pump #1 @ LA 14 April
 - ✓ Complete platform pile driving @ LA 25 April
 - ✓ Complete fabrication of pump #1 @ 17th St. 01 May
 - ✓ 1,600-cfs capacity operational at 17th St. 01 June

- ✓ Complete platform construction @ LA 24 June
- ✓ Complete platform pile driving 17th St. 06 July
- ✓ Complete platform construction @ 17th St. 08 July
- ✓ Complete pump system installation @ 17th St. 30 July
- ✓ Additional 8 pumps operational @ LA 05 August
- ✓ Additional 11 pumps operational @ 17th St. 15 August

Keys to Success

Many key elements led to the success for a project of this magnitude, namely good preparation, communication, teamwork, and staff, and a strong commitment to safety.

Preparation

The team started preparing for this project well in advance of issuance of the RFP. Key members of the team traveled to New Orleans and met with several local contractors, engineers, pump manufacturers, and material suppliers to begin evaluating potential team members and prepare subcontractor agreements. We also gained an understanding of the work being completed under the Phase I contract so that we could begin to outline subcontractor scope-of-work documents, determine the potential needs for the Phase II work, and begin to develop the schedule process and methods to reduce project time. The time between the proposal submission and award date was also used strategically. The team spent time developing the work plans, scheduling our goals for the first and second weeks of the project, and refining the project schedule. All of this preparation allowed us to hit the ground running immediately after award notification.

Communication

Clear, effective, and ongoing communication is extremely important in the success of a project of this magnitude. Through the various communication tools and techniques implemented on the project, WESTON was able to keep the team, subcontractors, clients, and other stakeholders well informed, and, most important, all “on the same page.” The team conducted several weekly meetings to ensure the project stayed on track, information was distributed quickly and accurately, and issues were resolved expediently. Weekly construction meetings at each site were held, at which the team discussed items such as health and safety, submittals, requests for information (RFIs), change orders, concerns and identified problems, Government Furnished Equipment (GFE) schedule, and action items. These meetings provided for open discussion, a chance to voice concerns, and a vehicle for getting real-time response, which was critical to meet the schedule. Weekly design meetings were held with the engineering staff to discuss similar topics and provide an opportunity to review all aspects of the design, specifically interface between the various disciplines.

Because of the critical schedule and its being the first major milestone, weekly meetings for the 1,600-cfs pumping system were conducted. Not only were the engineers, client, and contractors present, the pump equipment supplier was too, which provided the opportunity to review the fabrication schedule, coordinate equipment delivery, and resolve schedule issues. At the approximate midpoint of the schedule, the team began weekly startup and commissioning meetings. The team reviewed the startup plans and sequence, monitored construction progress, revised the sequence based on actual work completed, discussed roles and responsibilities, and identified other needs such as equipment manufacturers’ support. The GFE was a critical

component to the project startup plan. The GFE supplier attended the weekly startup meetings, which provided the startup team the opportunity to review the GFE startup plans and supplement these plans where needed. This interaction between the two parties was invaluable to the overall success of the startup.

WESTON set up several TeamLink sites, WESTON's Web-based collaborative workspace accessible from any computer with Internet access, a Web browser, and a user account, to store, share, and manage the project information. We posted drawings, specifications, submittals, RFIs, meeting minutes, work plans, reports, and all other pertinent information to TeamLink, making the information available to the clients, subcontractors, and other project stakeholders in real-time, 24/7. TeamLink proved to be an effective communication tool for all team members.

Teamwork

Another key to the project's success was the willingness of all WESTON team members, and some of our subcontractors, to be away from their homes and offices for extended periods. Although difficult, these long separations did enable the team members to dedicate themselves to the project full-time. Outside distractions and other project commitments were minimal at best and in most cases nonexistent.

The project staffing and how the team was assembled played an important part in the success of the program. WESTON's best and brightest employees were chosen from our offices around the country to work on this project. We required our subcontractors to assign their strongest personnel, from craftsman to management. The commitment of the senior managers from all organizations to getting the best people on the job was a key part of the program's success.

Commitment to Safety

However, the most important reason for this project's success was our attention to safety. The project complexity and stringent deadlines intensified the need for project safety, and the leadership from all organizations involved stepped forward to establish and reinforce the safety culture needed to make this project safe and successful.

The result of this effort was zero lost-time incidents over a 10-month period, with over 450,000 hours worked on a 24/7 schedule through the heat of the Louisiana summer. Several factors were instrumental in reaching this accomplishment: (1) The "Safety Every Minute Every Day" approach began with our proposal selection of the primary subcontractors; we required the subcontractors to have either a strong safety program or a genuine willingness to learn and adopt our safety culture; (2) having experienced and dedicated Health and Safety (H&S) Inspectors at each site for all shifts; (3) conducting daily H&S briefings so all workers and visitors were aware of the specific activities being conducted on the sites as well as the conditions; (4) closely monitoring construction crews for signs of heat stress and implementing mandatory break periods; and (5) celebrating our safety performance as the project progressed.

This commitment to the safety and health of all employees, subcontractors, and the public resulted in our receiving the U.S. Army Corps of Engineers Mississippi Valley Division's 2007 Regional Contractor Superior Safety Performance Award.

CONCLUSIONS

All 33 pumping systems were operational by mid-August, the height of hurricane season. The 1,600-cfs temporary system was in place by the start of the 2007 hurricane season as required. WESTON has followed up with the completion of the supporting facilities and has successfully closed out the project construction. WESTON is currently involved with Phase III, which includes automating the 1,600-cfs system with SCADA and installing additional platforms, plus other system enhancements.

The design-build contract mechanism was the primary key to the success of the project. Without this type of contract, the project would not have met the critical deadlines. The design-build contract allowed the team to perform design and construction activities concurrently, which was necessary due to the redesign resulting from the modeling as well as the 1,600-cfs system. This type of contract also was conducive for adapting to change “on the fly,” providing enhancements to the process as the project developed, and providing the opportunity to conduct ongoing value engineering and reviews.

This project was, we hope, a once-in-a-lifetime opportunity for most if not all of the project team members. Everyone involved took professional pride in the work they did, and also much personal pride in being part of the restoration of the City of New Orleans.