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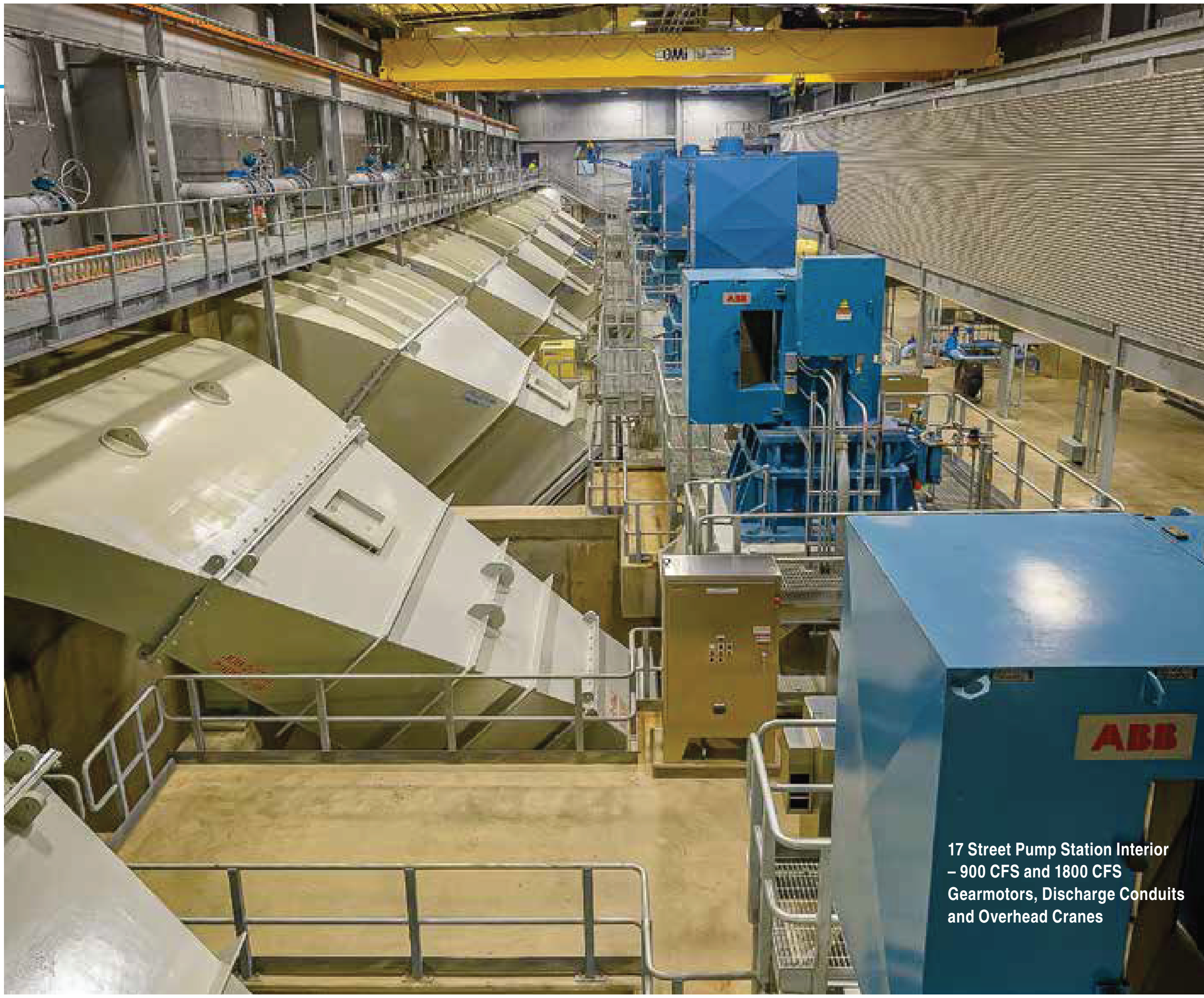

17 Street Pump Station Interior – 900 CFS and 1800 CFS Gearmotors, Discharge Conduits and Overhead Cranes

# Water resources design for long-term operations and maintenance

**John D. Take**, P.E., ENV SP, M.SAME, Senior Vice President (Water), Stantec Consulting Services Inc., Tucson, Arizona; **Daniel J. Grandal**, P.E., CFM, Vice President (Water), Stantec Consulting Services Inc., New Orleans, Louisiana; and **R. L. Mullins Jr.**, Ph.D., P.E., PMP, AICP, M.SAME, Senior Vice President (Programs & Business Solutions Group), Stantec Consulting Services Inc., Louisville, Kentucky

Today's public works officials face unprecedented infrastructure challenges with so many different needs converging at the same time from aging infrastructure to escalating maintenance costs to rapidly changing technology and advanced training for the workforce. Each of these challenges presents an operations and maintenance (O&M) hurdle. How best to deal with them? Anticipate and plan adaptability and resilience into the design of a project at the outset.

In the post-Hurricane Katrina environment in New Orleans, Louisiana, the Hurricane and Storm Risk Reduction System (HSDRSS) is now online and has recently been tested by Tropical Storm Barry. The U.S. Army Corps of Engineers' New Orleans District (USACE) joined with the State of Louisiana's Coastal Protection and Restoration Authority (CPRA) to implement the HSDRRS. This program was implemented in cooperation with local agencies (e.g., City of New Orleans, Sewerage and Water Board of New Orleans, Southeast Flood Protection Authority-

East, etc.). Operation, maintenance, repair, rehabilitation and replacement costs are the responsibility of the state and its local partners. This provided a special incentive to use best practices and innovative approaches to anticipate O&M challenges and design effective cost reduction measures.

The capstone project in the HSDRRS program was the Permanent Canal Closures and Pumps (PCCP) project—a design/build (D/B) contract. This $731 million project consisted of pump stations, floodwalls, levees, generators, and structures at the mouths of three canals: 17th Street, Orleans Avenue, and London Avenue. The stations serve a dual function as a 100-year-level storm surge barrier to keep Lake Pontchartrain from overwhelming the three canals while simultaneously pumping to prevent the damage seen during Katrina. Combined pump capacities are over 24,000 cfs, enough to fill an Olympic-sized pool in less than four seconds or the Mercedes Benz Superdome in less than 90 minutes. The stations were also designed to run independently without access to local power or water for up to five days. Operations and maintenance concerns and costs were a key driver in the design, given the need for a reliable and cost-effective solution for these mission-critical facilities over the duration of their design life.

Design and construction were accomplished using a co-location approach with USACE, CPRA, the contractor (PCCP Constructors, a Joint Venture consisting of Kiewit Louisiana Co., Traylor Bros., and M. R. Pittman, LLC), and the designer (Stantec Consulting Services Inc.) working out of the same office. This allowed for rapid input from all stakeholders to advance the design and construction and improve communication between designer, key stakeholders and future operators. An added bonus—it reduced the need for extended e-mail exchanges, it was easier to walk down the hall and address an issue rather than writing about it! This also provided the designers with access to O&M personnel to

FEMA 361 Operator's Safe Room

get real-time input on their issues, concerns and suggestions to make the design user-friendly.

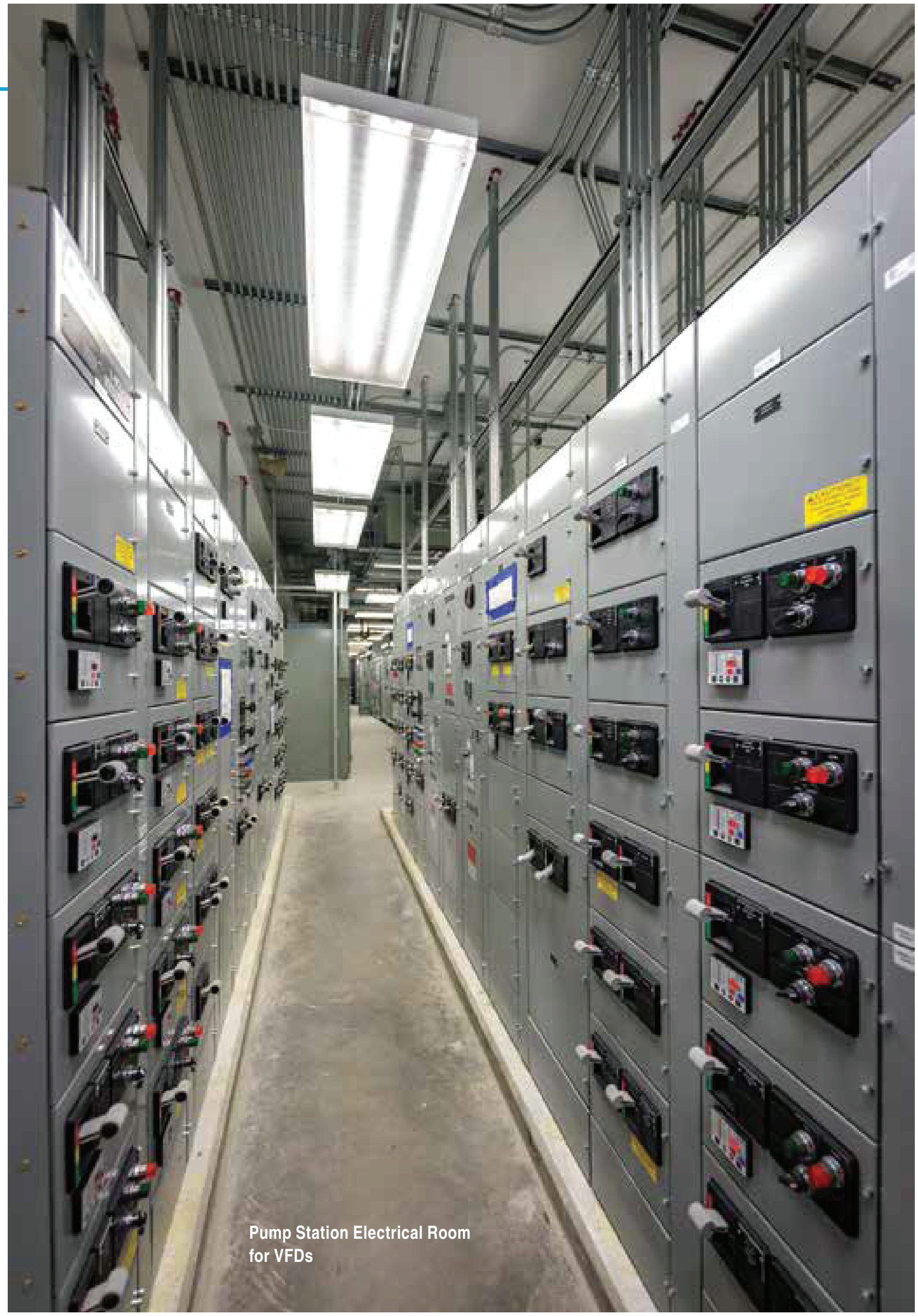
The long-term O&M costs guided the design because the design life of the station structures was 100 years, with varying design lives for components and equipment. Our design team had to evaluate each component for how best to contain these O&M costs and enable rapid response and reliability during a storm event. The following focuses on a select few project features and how the overall team worked to reduce anticipated costs.

In order to enable the station to start pumping, the slide gates that help form the surge barrier must reliably close. Without the gates in place, the station would not function as an effective surge barrier for the city. A real concern was how best to enable this under realistic storm scenarios. Each gate was designed with three means of positive closure. The first was using a command from the control room operator through the network. The station was also set up for remote control from an offsite location should that be needed. Second was local operation of the gate by a portable operator-powered gasoline engine in case of power outage and would connect to the HPU with quick connect fittings. Third and as a last resort, a manual process can close the gates.

Beyond operations considerations, the long design life for the structures required attention to reducing maintenance costs. Significant effort was put into corrosion control to reduce repair and replacement costs of the system components including many different features including the equipment (e.g., pumps); however, two items both USACE and CPRA focused on were the steel piling supporting the structures and the steel retaining walls. Pipe piles, H-piles, and other section types were used to support or comprised the different structures onsite. Because of the corrosive nature of the brackish water environment and soils in southeast Louisiana, extensive testing and corrosion modeling was incorporated into the design. Corrosion experts from USACE, CPRA, and Stantec's team worked collaboratively to test the soils and develop effective mitigation strategies (e.g., selection of materials, coatings, sacrificial steel sections, catholic protection, etc.). In addition, the team provided monitoring and maintenance systems creating a comprehensive corrosion maintenance plan to achieve the design life. Corrosion monitoring stations and criteria were included to allow O&M staff to determine if there was any unanticipated acceleration of deterioration over time. This helped the sponsor understand the long-term dynamics and effectiveness of the steel structures potentially affected by corrosion.

A key concern for protecting the integrity of downstream levees and floodwalls was erosion protection because of the high discharge capability of the pumps (a combination of 1,800 cfs and 900 cfs pumps was used, depending on the station). At 17th Street alone, pump capacity was 12,500 cfs resulting in high-velocity flows directed downstream. Several approaches were used based on the results of 1-D, 2-D and 3-D hydraulic modeling of the pumps and channels to cover both construction and long-term operation scenarios. The primary long-term solution was a concrete apron at the pump discharge and different gradations of riprap, depending on channel location, presence of side slopes and expectations for scour development. Physical and computational fluid dynamic modeling was used to evaluate different storm and flow conditions to establish an adequate level of erosion protection. Once again, balancing capital costs and long-term maintenance cost drove the design decisions. Similar to a "fire and forget" weapon, this, combined with a long-term periodic monitoring and replenishment program, provides greater assurance of performance as designed in-between monitoring events.

Additional tools that were used to facilitate operation and maintenance of the stations were Building Information Modeling (BIM) and 3-D spatial modeling programs. The facilities were modeled in three dimensions to allow for space requirements of replacing systems. For instance, the 3-D model replicated replacement of large components (like the large 5,000 horsepower vertical gear motors) using the overhead crane to move large equipment onto a truck adjacent to the overhead door access. Design of a laydown area to allow the operator to facilitate such repair processes was optimized. Due to the space restrictions within these facilities, this model allowed the designer to evaluate the space requirement needed for operation and maintenance of the facility and present them to the stakeholder. Other models included the more routine operations like access to the light fixtures and exhaust fans in the ceiling. Additionally, 3-D models were used to coordinate the design of exhaust fans and hurricane louvers regarding required environmental conditions such as temperature ranges in the buildings during hurricane conditions.



Pump Station Electrical Room for VFDs

These are just a few of the many examples of ways that the PCCP project was designed with both the input and concerns of O&M personnel in mind. This holistic approach to bringing O&M concerns in from the start made for an improved project and allowed those personnel to be better prepared to assume responsibility after turnover.

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