Safeguarding the Region's Water

San Diego takes refuge with a multi-faceted system of water facilities

BY MIKE FLANAGAN, SR/WA, R/W-NAC

As one of the most heavily populated regions in the country, it might be surprising to learn that San Diego, California has limited local water resources. With its semi-arid climate, the region actually relies heavily on imported water to support its 3.2 million residents.

Roughly, 80 percent of the water used by the county's businesses and residents comes from northern California and the Colorado River. Relying on imported water supplies comes with inherent risks. The county pondered whether their water supply might one day suffer from earthquakes, an extended drought or regulatory cutbacks on pumping from the fragile San Francisco-San Joaquin Bay-Delta.

PROTECTING THE COUNTY

In the face of a potential threat to the viability of the region, the San Diego County Water Authority (Water Authority) decided to attack the problem head-on. They acted proactively when they conceived the Emergency Storage Project, a multi-faceted, integrated system of major water facilities designed to safeguard the region's water supply in the event of a natural disaster or a prolonged drought. New water storage facilities and pipelines will allow the county to store up to six month's supply in the event of an emergency that disrupts the water supply. The expanded pipeline system will facilitate region-wide water distribution by supplying over 190,000 additional acre-feet of water to areas where it might be needed.

With the goal of protecting the region from potential disruptions of the water delivery system, the project is being constructed over a 14-year period at a cost of approximately $1.5 billion.

FOUR MAJOR COMPONENTS

The Emergency Storage Project's four major components have either already been built or are currently under construction. They include the Olivenhain Dam and Reservoir, Lake Hodges Pipeline and Pump Station, San Vicente Pipeline, Pump Station and Surge Control Facility, and the San Vicente Dam Raise.

Completed in 2003, the Olivenhain Dam is the tallest roller-compacted dam structure in North America. At 318-feet tall, it was designed and constructed to withstand a 7.25 earthquake and remain fully functional. The electricity it generates has enabled the Water Authority to produce revenue at the same time it protects the region's viability.

The reservoir, which can store up to 24,000 acre-feet of water, is currently filled with enough water for 50,000 families a year.

The Lake Hodges Pipeline and Pump Station facilities are designed to connect the new Olivenhain Reservoir to the Hodges Reservoir through a 10-foot diameter pipeline. This connection will allow water in the Hodges Reservoir, which previously served a limited area to be delivered by the Water Authority throughout the region. The reservoir provides 20,000 acre-feet of emergency storage capacity. A power generation facility constructed as a part of the project will have capacity to produce 40 megawatts of peak hydroelectric energy. This green energy can power 26,000 homes annually, while creating significant annual revenue to offset the costs at the Lake Hodges facility.

The San Vicente Pipeline is an 11-mile underground tunnel linking the San Vicente Reservoir with the Water Authority's Second Aqueduct. In an emergency, this connection allows water from the reservoir to be distributed to water agencies in the county. A 3.3 million gallon, 217-foot diameter surge tank was constructed to handle sudden surges in the pipeline that could damage the valves or meters regulating flow control. Three power pumps convey water uphill, where it begins its 11-mile long gravity flow west to the second aqueduct. The pipeline makes it possible to deliver water to the San Vicente Reservoir and then transfer it back to the second aqueduct, where it can be supplied to the central and southern portions of San Diego County. The San Vicente Pipeline, surge tank and pump station were completed in 2010.

Raising the height of the San Vicente Dam is the last major component of the project. This project scheduled for completion in 2014, is unique in that the existing dam and reservoir will need to continue functioning as a water source for the city of San Diegothroughout the entire construction process. Once the dam is raised from 220 feet to 337 feet, it will become the tallest dam raise in the United States. Its capacity will increase from 90,000 to 242,000 acre-feet of water, reserving roughly 152,000 acre-feet of storage capacity for the Water Authority. The dam and reservoir are owned and operated by the city of San Diego, which will retain its original operational storage capacity.

Officials break ground at the San Vicente Dam. From left, Tom Wornham, Secretary of the San Diego County Water Authority Board of Directors, Water Authority General Manager Maureen Stapleton, State Natural Resources Secretary Mike Chrisman, San Diego Mayor Jerry Sanders and Claude "Bud" Lewis, Chairman of the Water Authority Board of Directors.

To make way for the San Vicente Pipeline tunnel, an 11.5-foot hard rock boring machine was used to penetrate 5,255 feet of granitic rocks.

THE TEAM

A multi-disciplinary project team was assembled to include at least one member from every department within the Water Authority. Professionals from engineering were needed to oversee the design, project management, construction, contract administration and CIP project controls. The right of way staff managed the acquisition and surveying requirements, while the water resources department handled planning and environmental issues. Cathodic protection and operations were overseen by the operations/ maintenance staff. The public affairs group was responsible for creating and coordinating local outreach programs. Finance and risk management were also part of the team.

Integral to the team were the private consultants who had specialized knowledge in engineering feasibility studies and planning, dam design, construction management, environmental mitigation, public affairs, reservoir operations and right of way. Liaisons from various government offices, such as the California Department of Water Resources and the city of San Diego, also contributed as team members. The State Board of Senior Consultants and a dispute resolution panel were included, as well.

Alignment training was conducted with all members of the team and went a long way in reinforcing a "project first" mentality. Each team member addressed issues within their area of expertise in collaboration with the project manager and project team. When issues overlapped, team members from multiple departments worked together or formed ad hoc teams to brainstorm solutions. During monthly team meetings, members reported the status and progress of issues and action items related to their area of expertise. Critical issues were deliberated,

The public affairs team tailored ongoing outreach programs to help minimize community disruptions.

including identification and possible mitigation measures for potential high-probability, high-impact risks. Such discussion was integral in helping to create contingency plans to maintain scope, schedule and budget.

PASSING THROUGH THE GATE

During the construction phase of each component, weekly meetings were held on-site to review and discuss issues encountered by the various contractors and sub-contractors. An action item log tracked the status of issues impacting the project, as well as expected completion dates for resolving those issues.

The team used a gate system to manage the various stages of the project. This system separated the project into segments, such as preliminary design, mid-point design, final design, construction readiness, beneficial occupancy, notice of completion and project closeout. Within each gate, a checklist of deliverables needed to be completed before the team advanced to the next gate. Team members would sign off on the checklist when all of the deliverables within a particular gate were accomplished. The Project Manager would then present the completed gate to the Gate Group, a committee of managers who would determine whether the project team could pass through the gate and begin work on the next stage of the project.

As the team progressed from component to component and gate to gate within each component, a risk register was compiled to help anticipate potential pitfalls the project might encounter. Solutions to these potential problems were brainstormed in advance to reduce any downtime should a problem actually occur. The combination of training, monthly team meetings, weekly construction meetings and the gate process proved highly effective on two levels. First, it ensured the team was focused on issues immediately in front of them, and second, it enabled the project to remain on track.

LEARNING ALONG THE WAY

A project of this magnitude is certain to generate some unique challenges. One lesson learned early in the process involved the need to develop a prequalification program to ensure contractors selected were qualified for their particular job. For example, roller compacted concrete is a complex construction method, and the project had an aggressive construction schedule. Establishing the prequalification program ensured that the four final bids received for the dam construction were all submitted by qualified contractors or joint ventures. The program was so effective that the Water Authority amended its Administrative Code to ensure prequalification was incorporated into future projects.

Another lesson came from using designs by two different engineering firms for separate components that directly interfaced with one another. Questions arose concerning a particular pipe connection at a critical interface between the dam and pump station. While the physical pipe size, type and centerline locations of both designs coincided, the structural support design was not coordinated. One of the pipes was encased in concrete while the other used a standard soil-compacted trench. This, of course, led to questions about settlement and possible pipe movement. Taking time to analyze and resolve the issue resulted in additional costs and impacted the schedule. In the future, when different engineering firms design components that interface, the firms will be required to address all aspects of the interface (structural, mechanical, electrical and controls) in memo format, signed and stamped by engineers from both firms.

A partnering process developed for the Olivenhain projects was based on a strategic approach to problem resolution. Stakeholders at the Olivenhain Dam included the Water Authority, contractor, design engineer, safety, regulatory agency and construction manager. A partnering charter was developed through collaboration and unanimous approval of five goals: safety, quality, schedule, cost and teamwork. An independent third party facilitated the partnering. The success of this partnering experience demonstrated how it was in everyone's best interest to have open, cooperative communication from all parties involved in the project.

A lessons-learned database was established and continues to be maintained by the Water Authority. It has proven highly effective for reviewing problems encountered in previous phases of the project and works to prevent these problems from disrupting other phases of the project. The database currently has nearly 100 lessons learned to help address future issues.

OVERCOMING THE HURDLES

The project team was able to overcome some significant challenges. The portfolio of large projects comprising the project created numerous impacts to the environment. Team members from the Water Resources and Engineering Departments, along with design and environmental consultants, worked to ensure the

project complied with NEPA/CEQA requirements through a Programmatic Environmental Impact Report/Environmental Impact Statement. For some components of the project, individual EIRs were prepared to further analyze impacts and to propose measures to mitigate those impacts. Through the acquisition, preservation, or creation of wetlands and other open space areas, the preservation of sensitive habitat has been maintained.

Another hurdle arose with the construction of the 11-mile San Vicente Pipeline. The pipeline route tunnel was designed to pass under freeways and public streets, avoiding commercial business districts and residences. Although many geotechnical core samples had been analyzed along the tunnel route during design, the contractor encountered differing site conditions in several locations, requiring modifications to the tunneling excavation methods and equipment. The project schedule and budget were continually monitored and adjusted to accurately reflect the tunnel progress.

For the San Vicente Dam Raise, the Department of Environmental Health in San Diego County required a restrictive setback of 1,000 feet from the high water mark of a reservoir. The team researched the setback requirements in other California counties and determined the average setback from a reservoir was only 200 feet. They worked with the county to reduce their stringent 1,000-foot setback to match the typical 200-foot setback used throughout the state. This agreement with the county saved the Water Authority millions of dollars in land acquisition costs.

PUBLIC OUTREACH

Initially, the local opposition was significant in both rural and suburban communities where the components were constructed. Residents and community groups objected to the noise, traffic, dust, safety issues and other disruptions that can arise from large-scale construction. Rural residents were especially concerned about any permanent impact the completed facilities might have on their secluded communities.

To address concerns and identify ways to minimize community disruptions, the Water Authority's public affairs staff teamed up with a consultant to customize a community outreach program. The outreach vehicles included newsletters, postcard updates, community meetings, emails, phone calls, project tours and one-on-one briefings.

Throughout the many phases of design and construction, the team maintained open communication with the public. This worked to keep interested parties engaged in the development of these critical public facilities, while reinforcing the Water Authority's goal of enhancing water reliability for the region. The team was so responsive in answering questions, concerns and complaints that some of the most vociferous project opponents actually became project champions.

Scheduled for completion in 2014, the San Vicente Dam raise will nearly triple the current water capacity.

BUILDING RELATIONSHIPS

Building a trust-based relationship with two major stakeholders—the city of San Diego as owner and the Division of Safety of Dams (DSOD) as regulator—was crucial in helping to move the project forward. The team members from design and engineering, along with the design and construction management consultants, worked diligently with the California Department of Water Resources, DSOD to gain the necessary approvals during each phase of design and construction.

The project team coordinated with the city on all aspects of design and construction to ensure that the city's operational requirements were met. They also worked together to define how the expanded reservoir would be operated and maintained for both agencies. Representatives of the city water department played an integral role within each design and construction work team.

The completion of the Emergency Storage Project will not change the fact that San Diego County will still rely on imported water for the majority of its water needs. Today, residents and businesses are still encouraged to increase their water conservation efforts, as the Water Authority stays focused on overseeing and protecting the county's water supply. The Emergency Storage Project will however, provide a much needed buffer against future water shortages.

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