Advanced Main and Lateral Lining Techniques

Bill Bachelor

Patrick Air Force Base, action-central for shuttle launches on Florida's Space Coast, is a sprawling complex of housing developments, administration buildings, and an airfield. It is sandwiched between the Atlantic Ocean and the Banana River. The base housing area is serviced by the Cocoa Beach Sewer Treatment Plant via two lift stations with capacities of 3.6 and 6 MGD. The collection system is in generally fair condition despite being over 40 years old. Sewer mains vary in depth from 4 to 14 feet, and much of the system is under water throughout the year.

The condition of the plant is sorely tested during the rainy season when the water table often rises over two feet and completely covers the aged pipe, much of which shows fractures in the mains and joint breaks at the lateral connections. The situation became critical in 1990, and the office of the Patrick AFB Civil Engineer retained an engineering consulting firm to devise a rehabilitation plan. A TV inspection was ordered, and the 999-home Capehart Housing Development was identified as a prime surcharge area.

The strategic plan divided the neighborhood into three priorities. The first priority was identified as 126 homes on ten streets with 13,004 feet of mains, 50% of which were 8-inch pipe, 42% 10-inch, and 8% 12-inch. Laterals measured 3,077 feet with an average length of 24.2 feet. The longest was 101 feet.

The Base Civil Engineer and the consulting engineers joined with the Mobile District of the Corps of Engineers to write specifications for a bid. The specifications called for all mains and laterals to be relined with a cured-in-place material.

Four firms responded to the invitation. The low bidder was passed over, and the contract was awarded to a company that used a cured-in-place material exclusively for all mains and laterals. The sole source provision for CIP material drew a protest from Griner's Pipeline Services of Mt. Dora, which advocated a multi-source approach. The protest was turned down on "technically non-responsive" grounds. An appeal went to the regional office of the Corps in Atlanta, and was turned down. Griner's Pipeline Services took the protest to the final authority for the Corps in the Pentagon, and a second bid was ordered.

The new bid opened the door for contractors to use more than one type of material. PPI of New York was low bidder, and a performance bond was issued with a 12 month deadline for job completion.

After six months on the job, PPI had televised and cleaned the lines but had not started rehabilitation. PPI wanted to use polyethylene material in the mains and connect the laterals to the main with mechanical fasteners. This required excavation at the lateral-to-main connector, and the Patrick engineering contract was predicated on installing the new mainline and lateral feed without excavation. Therefore, PPI's modifications were rejected.

Another requirement upon which the Corps insisted was an air test for the entire system at the completion of the lining phase to guarantee and air- and water-tight connection between the laterals and main.

The air test specs were hammered out between the contractor and the Corps using NASSCO guidelines and the latest available technical information. If TV inspection showed any sand infiltration prior to relining, the line was pre-grouted. If only water was apparent, the line could be purged during the inflation process and pre-grouting wasn't necessary.

A double bladder was placed in the main and pulled in place over the lateral, and the upstream end of the lateral was plugged at the clean-out. Once the lateral was isolated, a 3.5 psi air pressure was introduced through a control valve at the clean-out plug and maintained for a minimum of two minutes. After the two-minute stabilization period, the test required the line hold at least 3.0 psi for two minutes in 4-inch lines, four minutes in 8-inch lines, and five minutes in 10-inch lines. If the groundwater table was above the line being tested, test pressure was increased by 0.43 psi per vertical foot of groundwater above the inverted level of the section tested. This compensated for the head pressure of the groundwater.

Four and one-half percent of the laterals required point repairs prior to installing any CIP material. Repairing the lateral host pipe accomplishes two objectives: it prevents future infiltration between pipes migrating down the lined pipe to future joint leaks, and it prevents the epoxy resin from extruding through the host lateral and lessening the amount necessary for an effective cure of the CIP material.

With just six months left to complete the job and only preliminary work completed, Griner's Pipeline Services joined PPI as a white-knight subcontractor and began the task of rehabilitation. To prove that laterals can be permanently bonded to mains using a chemical epoxy, Griner's Pipeline Services was willing to provide the extra manhours and materials necessary to finish the job on time and incur the resulting financial loss.

After the contract had been awarded, another problem arose for which neither the Corps nor the contractor was prepared. In the 1970's many of the laterals had been improperly repaired by opening the service connection and ramming a smaller pipe into the lateral until the liner pipe hit a "y." Unfortunately, many of the smaller liner-pipes cracked the host pipe, resulting in leaks. The contractor had to open the laterals at the cleanout and remove pipes that had been frozen in place for over 20 years.

Once the mains and laterals were clean, the contractor used CIP Liner for laterals and PVC AmLiner for the mains. The key to bonding dissimilar materials was a trial and error evolution of epoxy resins. The contractor worked with a Florida company that custom blended a two-part epoxy with special additives to effect a permanent union of the two types of pipe.

The tricky part of the job was lining the laterals, and creating an airtight union to the mainline. The contractor decided to double the thickness of the epoxy impregnated cured-in-place lateral liner for the final twelve inches where the liner meets the main, accomplishing two goals: doubling the liner thickness and doubling the amount of epoxy at the critical lateral-to-main connection.

The contractor learned the hard way that the normal curing time of 2 to 3 hours easily expands to 4 or 5 hours when high infiltration of water is present. This limits repairs to only two or three laterals per day instead of the anticipated five or six. Pre-grouting also helps prevent epoxy from washing out when water had infiltrated the lines.

Another expensive learning curve was conquered when the contractor figured out how to cut the Masterliner in a unique "S" shape at the main entrance. Much time is saved once this trick is mastered, and the epoxied material neatly contours to the wall of the main, eliminating cutting and shaping.

The actual technique for installing CIP Liner is straightforward. A messenger line is sent to the nearest downstream manhole, and the inflation bladder is inserted in a steel bullet head with a swivel leader pulling the entire parade through the lateral without twisting the felt tube. If there is any twisting, the S-shaped curve will not align with the opening into the main.

Once the TV camera in the main line sees that the inflation bladder has been correctly placed, the entire lateral liner is inflated to conform to the original service lateral. The double reinforced end piece is flared smoothly to the main line wall. The amount of felt material extended into the main is critical—too much material requires extra time to go back in the main and trim the excess.

Whenever a lateral did not meet the air test, the contractor was allowed to grout. Griner's Pipeline Services preferred 3M urethane, and all lines met the requirements of the air-test.

Prior to re-lining, the lift station recorded 0.71 MGD, peaking at more than 1.1 MGD during heavy rain periods. After rehabilitation, flow was reduced to 0.468 MGD with negligible increases in wet weather. This improvement was recorded in spite of a hurricane and a tropical storm adding hydrostatic pressure to the system during the evaluation period.

The job was successfully completed within the 6-month period. The CIP Liner exhibited a uniform circumferential wall thickness, and little if any epoxy migrated to the bottom of the pipe.

The process needs refinement before a perfect seal can be achieved every time, but at this point the connection is airtight with the grouting. Refinement is needed in formulating the epoxy, and modifications should be made in the configuration of the felt tube. There are inherent problems with any type of lining system, and each contract has to be engineered individually. Unfortunately, we face cost constraints or may rely on sales presentations leading to some failed lining jobs. Recent failures on non-military projects have caused concern in the political and engineering communities, resulting in widespread interest in this project and how Griner's Pipeline Services' techniques worked.

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Customer Relations: The Seven "C's" for a Successful Infrastructure Rehabilitation Program

David Collier, Sterling L. Carroll and William F. Archebelle

Platted in the early 1900's and containing about 121 acres, East Stuart is one of the oldest neighborhoods in the city of Stuart. Because of the area's age and need for preventive maintenance, the existing infrastructure had seriously deteriorated. Sanitary sewer lines were in need of replacement, water mains were undersized, roads were substandard, and the drainage system functioned poorly. The city's goal of maintaining good customer relations was a central objective for the success of the infrastructure rehabilitation.

Conceptual Planning

Infrastructure rehabilitation projects begin years before the first pipe segment is placed. First, the potential project is identified, catalogued, and defined in the conceptual planning stage. Beginning with the first water main break, complaint of low pressure, sewer-created pothole and drainage problem, the need for infrastructure rehabilitation in East Stuart surfaced as a concern. The city public works director and manager began to see a pattern of trouble which eventually grew to be a major concern.

The project was accelerated because of failing gravity sewer and water lines causing potholing and collapsing pavement throughout the East Stuart area. Infiltration and inflow studies showed that large portions of the gravity sewer system were cracked, leaking, and compromised beyond repair. Infiltration was a major concern.

The water system contained small diameter (1-inch and greater) galvanized water pipe reaching the end of its useful life. Utility crews had to return to the East Stuart area frequently to maintain and repair water services. In addition to the aging water mains, the services had been installed in a non-traditional pattern. The pattern was haphazard and it was nearly impossible to predict where an individual residence was connected to the main, or how many units might share a single service tap. It was not uncommon for a water service to have half a dozen homes on a l-inch tap. In addition, lime deposits in the pipe had progressed to a major extent, further limiting flows and pressures.

Also, the East Stuart area had no central drainage system. Research showed that several homes and businesses were built-over historic lakes and low spots and routinely experienced flooding during storm events.

The rehabilitation of the water, sewer, and drainage infrastructure would require the replacement of nearly all paved surfaces in the area. The excavation required to replace existing utility lines typically impacted the entire right-of-way. Conceptually, roadways were narrowed to provide room for streetscaping and additional sidewalks and to help in reducing traffic speed.

Having initially identified the needed improvements, the first two issues that the city and utility professionals addressed were the scope of the project and its cost. The initial cost estimate for all three phases of the work was $6 million. Considering that the city's annual budget was $7.5 million, the project was not feasible. A more realistic budget of $4 million was established and the project was timed to two phases.

All too often, the need for rehabilitation is well known but the source of funding is not. A major component of the East Stuart Conceptual Plan was to identify financing sources. These included Community Development Block Grants (CDBG) for the water and sewer replacements; gas taxes for the road and drainage improvements; and Capital Improvement Bond Funds for the balance of the work.

From the first statement of need, the rehabilitation program had a definite focus, which was documented in the conceptual plan. It outlined the project approach, statement of need, design criteria, cost estimates, plan for improvements, and financing strategy for both project phases.

Community Input

More than ten public workshops were conducted in the East Stuart community throughout the conceptual planning and construction portions of Phase 1. Also, numerous city commission meeting discussions centered on the project.

The public awareness program was designed to solicit and receive input from residents, property owners, community leaders, and business people affected by the proposed project. Meeting notices were posted throughout the community, delivered to community churches, published in the newspaper, and delivered to key community leaders.

The most successful manner of receiving community input occurred after the project was actually in construction. The purpose of community meetings was to receive input on design, to inform residents on progress of the construction work and address questions, and to report to the city commission. Community input played a key role in the initial design of the surface improvements (roads, sidewalks, green space, landscaping and lighting). One of the results of citizen comment was the design modification to parking and landscaping along several major thoroughfares. In several cases community input actually modified the project's design. As construction proceeded, residents who had not initially attended meetings in the conceptual planning phase became more aware and interested in the changes in their community.

Post-construction input was also solicited to insure public satisfaction with Phase I construction. Comments received were also used in Phase II design and contract documents to minimize construction impacts and improve contractor performance.

Communication

Several major surprises occurred during the construction phase, one of which was the discovery of transite (asbestos-cement) water lines. The decision to replace the transite with ductile-iron pipe had to be made promptly in order to keep the contractor on schedule.

Soil in the East Stuart area consists mostly of fine sand. Excavation was difficult and traffic could not pass through the construction area. Traffic control and resident access were major concerns and the subject of frequent communication with the contractor. Daily inspections and drive-throughs by both city and engineering personnel provided the regular contact and communication needed to obtain and maintain control of the job site. The visibility of the resident project representative provided an opportunity for citizens and city personnel to communicate issues and concerns.

Communications were tested when several extreme rain events (25 and 100+ year storm events) occurred. Communications were vital in monitoring, assessing and fixing problems.

Correlation

Improvements were correlated with other important issues. The replacement of failing gravity sewer lines and undersized water mains were correlated with stormwater issues. Drainage was a major concern in the East Stuart area. Frequently, flooding problems were solved along with improvements to the water quality of run-off. Existing lakes were cleaned and dredged. Weirs and pollution control devises designed for installation. Lakes were added to the system to control hydraulics and to assist in improving water quality as flows eventually enter the St. Lucie River and Indian River Lagoon.

The magnitude of replacing the water and sewer lines, coupled with the upgrade and installation of stormwater facilities, meant that most of the streets and pavement would be disrupted. The objective of the rehabilitation project was also correlated to improvements and the redevelopment of the community. A streetscape concept of beautifying and enhancing the community was incorporated into the design.

The streetscape concept included landscaping, lighting, park benches, sidewalks, and other improvements. The landscaping plan included the placement of Live Oak, Sabal Palm, Beach Dune Sunflower, Pygmy Date Palm, and park benches in planters through the area where space was available. The lighting plan increased street lighting by 40 to 50 percent, improving security and visibility.

Cooperation

The design team and city staff were sensitive to issues and concerns of consumers. A high degree of cooperation existed among the parties. A good example of cooperation between the city, engineer, and contractor was the flexibility to change project objectives as a result of citizen comment. Work was delayed or rescheduled as the changes were proposed, recommended, and approved, with the cooperation of all parties. The residents and business owners cooperated with construction by displaying patience as water, sewer and drainage work affected their lives and paving activities followed.

Construction

Construction activities need to be controlled and focused on the effective installation of improvements along with sensitivity to customer issues. Control of construction is retained through oversight, inspection, and monitoring activities. Workshops were held to hear, address and monitor concerns during construction activities. Flexibility was extremely important in tailoring the project to the expectations of the community.

Closeout

Pre- and post-construction videos were produced to document the goals and results of the rehabilitation program. The videos clearly showed the improvements for residents and commissioners to view and analyze the progress. During Phase I of the reconstruction, new drainage structures were built and broken pipes replaced. Lakes were cleaned and expanded to accommodate stormwater runoff. Roads, parking lots, and playgrounds now drain efficiently.

The visual results of the East Stuart revitalization project are readily apparent, but the real value of this project is the way it has touched the people who live there. These changes have the capacity to improve the quality of life and instill pride in the community. Because of the infrastructure improvements, new businesses are finding a home in East Stuart and local residents are finding ripe opportunities for opening a business of their own. Buildings that once had high vacancy rates have now attracted new tenants.

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Meter Reading and Custom Service Outsourcing

Frederick Bloetscher and Whitfield R. Van Cott

The city of Hollywood has experienced a number of problems with water billing functions in the past several years. Various attempts have been made to address specific issues, each time with new issues arising. Problems have included the perception that meters are not read or not read accurately, bi-monthly estimates, customer service response, meter accessibility, and customer complaints.

To review the problem in a comprehensive manner (from meter reading to receipt of revenues), a task team was created in an attempt to identify areas where productivity could be improved and processes streamlined. Immediate improvements were encouraging.

The directive to the process improvement team was to evaluate all meter reading, customer service, and billing issues, including alternative mechanisms for delivery of billing services and operational and organizational impediments to smooth delivery of billing services. Evaluation of alternative service delivery methods required the staff to review options to improve the city's water and sewer billing and meter reading services to provide monthly reading of meters; reliable, user-friendly customer service; accurate, customer friendly billing services; and fewer service complaints. A key concern was the protection and maintenance of the city's customer database.

History

Each month 19,000 of 38,000 meters are read. Since billing is done monthly, those meters not read are estimated based on past usage. Despite the perception that many meter readings are incorrect and/or meters are not read, data indicate that incorrect readings are well below one percent. Most of the errors are due to access problems.

Efficiency is measured by a direct comparison of the costs to read the meters divided by the number of meters read on an average day. This value is compared to neighboring private providers, but the comparison does not account for differences in topography, meter access, meter location, or obstacles.

Meter routes have not been reviewed since they were first set up, in some cases in the 1950s. Multiple routes were not loaded into the reading devices, so no additional work could be completed once the route was read. This creates between 2.5 and 3 unproductive hours each day per reader. The meter reading division also has been the focus of union activities which has led to some resistance to changing work methods.

Processes were enacted to attempt to correct many of the problems. Monthly billings based on monthly meter readings was determined to be the key factor for overcoming many customer service perception problems.

On the customer service side, over 260 phone calls come in each day, mainly for account inquiries. The second biggest cause of calls was identified as turn-ons and turn-offs. Monthly billings based on bi-monthly readings also confused many customers as well as the billing clerks.

One of the most time consuming problems is when customers complain about their usage. People typically argue that they could not possibly use the water shown by the readings. This is a difficult problem to address in light of the meter reading and bi-monthly estimate problem.

When complaints about water usage occur, verification of the meter reading, required to be checked by ordinance, was not done on a work order, but by verbal request, so no paperwork could be provided to the customer. If the customer remained dissatisfied, the city conducted a meter test, whereby the meter was physically removed and bench tested, and the results compared against the standards for meter accuracy established by AWWA.

To alleviate part of the problem, a written policy on resolving disputes was developed in conformance with the current city code, which addresses limitations for the staff with regard to water bill adjustments: either the meter reading is incorrect or the meter is defective. Since meters do not read fast, any error in accuracy benefits the customer, not the city. A water audit option was also implemented to provide guidance to the customer on potential leak problems.

In-House vs. Outsourcing

In evaluating alternative service delivery methods, the city determined that meter reading costs were $1.26 per read. This cost, with an implementation of efficiency methods and a complement of eight readers with performance standards, could be improved. However, to attain this productivity, all routes must be reviewed and updated. Access rights need to be enforced. This problem looms larger if a contractor is hired to do meter reading.

In-house meter reading would be done on a task system; when the work is done, they go home. Failure to complete the work or weather conditions might require additional time and weekend work. In addition, any errors in meter readings would be the responsibility of the reader to correct on personal time. Re-reads would cease to be the responsibility of the customer service representatives, although they would do periodic checks to assure quality compliance.

The staff reviewed the city's meter billing operations for costs. The cost of mailing was 27 cents per item. For sorted mail, this cost could be reduced to 22 cents. Computer time is a fixed cost of about 20 cents per bill, a cost which would remain with the city whether or not billing is contracted. Billing costs could be decreased from 94 to 73 cents per bill, based on cost reallocations, improved utility billing system response , and decreased work orders. The billing staff is proposed to remain basically the same. Phone calls would be reduced.

The city decided that measuring its abilities could best be accomplished by comparison to outsourcing. The city requested letters of proposal for privatization of some of the services. While the option was thought to be able to economically help the city in some ways, the city identified a number of issues that must be addressed, both administratively and contractually including:

1. How is quality assurance of the meter reading program maintained — who checks the contractor? Some city capability to verify accuracy of meter readings on a regular basis, to administer the contract and answer complaints about contractor performance, must remain. These people should be familiar with the system.

2. If the contractor does not perform, how is the meter reading

done? In-house capability should be maintained until the city is assured of the quality of performance by the contractor. This may include allowing only a portion of the service to be contracted at present.

3. Customer interface questions must be addressed. The contractor will not always be able to resolve issues. Interface between city staff, the customer, and the contractor must be proceduralized and administered.

4. Work order generation and staff interface must be created. The most probable concern is access. A full-time person may be necessary to keep up with access problems and to address city easement rights.

5. Education of the customer with respect to meter reading practices and reading times must be addressed. The typical response will be to the city, not the contractor. The city will retain ultimate responsibility in the customer's eyes.

6. Escalation of the meter reading service will occur. Cost containment will be a problem in the future as there will be no staff comparison for it.

7. The city will lose the corporate memory of current readers. Despite the accumulation of the mapping and meter reading device data, long term information on the meters, location, and problems will be lost.

8. The access problem must be addressed for optimum savings via a contract reader.

After reviewing the entire meter reading and billing procedure, the team recommended that the city:

1. Contract meter reading;
2. Pursue monthly meter reading as soon as possible;
3. Consolidate meter reading, billing and customer service into one division to coordinate efforts and consolidate responsibility, especially if portions are outsourced.

RFP Process

The task team reviewed outsourcing options for meter reading, customer service, and billing. A Request for Proposals for Meter Reading/Customer Service/Billing was issued. A copy was sent to the six firms that responded to the RLI, and proposals were received for three scenarios: meter reading only, customer service and billing only, and full services (including both meter reading and customer service). The proposers were allowed any combination of bids.

Six proposals were received and distributed to a selection committee comprised of management personnel. Each proposer was given the opportunity to make oral presentations to the selection committee for the purpose of clarification and to allow for questions and answers from the selection committee. After independently evaluating and scoring, the proposals for the three alternatives, the evaluation committee met and the proposals ranked for the three proposal alternatives. A ranking was forwarded to the city manager for review.

The city manager interviewed each of the six proposers separately in an effort to form a final recommendation to the city commission. Comfort with a vendor acting in a visible and potentially controversial situation was of prime importance.

Analysis of Proposals

The city received two proposals for meter reading only. Evaluations of the proposals were based on:

1. Implementation plan to dedicate appropriate resources;
2. Capability;
3. Qualifications of personnel assigned;
4. Demonstration of successfully completed similar projects;
5. Proposed cost.

During the evaluation of the meter-reading-only proposers, the selection committee reviewed references, discussed past performance, and raised issues of concern.

Alternative 1 - Meter Reading Only

The RFP required that services under this alternative include the reading of all 39,000 meters on a monthly basis, that accuracy be maintained (with penalties for failure to do so), and that all field services (turn-ons, turn-offs, leaks checks) be performed by the proposer's forces. Two firms submitted proposals for this alternative.

Costs for both proposers was on a per-meter-read basis. The Public Utilities Department had serious concerns that neither proposal included enough money to perform both monthly meter reading and the field services that the city now performs (1200 work orders per month).

Alternative 2 - Customer Service/Billing Only

The RFP required that each proposer establish an office within the city, staff it with customer service personnel who could respond to customer billing inquiries, address billing problems, check bills prior to mailing, request re-reads of the meters, prepare and send bills and receive in-person payments. This alternative also required that each proposer utilize its own computer equipment.

Costs for all three proposers was provided on a per-account basis. The city's proposal was ranked first.

Alternative 3 - Full Service

Alternative 3 had the requirements of both Alternatives 1 and 2. Three proposals were submitted. The city employees declined to bid. Costs for all three proposers was provided on a per account basis (both meter reading and billing/customer service

Alternative 4 - Full Service using City Computer

The recommendation of the first in-house review team was to outsource meter reading only. However, the city declined to bid on this work and the proposals received were not satisfactory. While the city did bid on the customer service and billing portion of the work (Alternative 2), Alternatives 1 and 2 must go together. The full service bids (Alternative 3) did not provide the desired savings when the costs that must be reallocated are taken into account

As a result, discussions were held with each of the full service vendors to discuss options for cost reductions. Since data processing was one of the major cost reallocations, a review of the value, potential for obsolescence, and abandonment of the utility billing system were made. The current system is two years old. The information services director estimated that over half is original value remained in the computer system and did not recommend its abandonment.

As a result, a new set of criteria to evaluate the firms was overlain on the previous ones:

1. Willingness to purchase computer services from the city;
2. Reduction in costs for computer services (via lease, actual operation or user fees); and

Continues Page 31

Alternative Project Delivery - When Is It Appropriate for Florida Utilities?

Keith Rice, Richard Dyne, Tom Cleveland, and Robert Hungate

In the water industry, the traditional design-bid-build approach has been the dominant project delivery method for over 100 years. Owners, consultants, contractors, and regulators all understand how it works, and customers and political governing bodies accept the results.

During the last several years, Integrated Project Delivery (IPD) methods have been used in a steadily increasing number of projects, particularly in Florida and California. Why is the industry adjusting course after so many years? Because there are some inherent drawbacks in the traditional approach.

The traditional method fosters adversarial relationships among the contractor, owner, and engineer, which can often lead to unsatisfactory results in terms of cost, timeliness, and project quality. It usually does not incorporate contractor input during the design, and that eliminates constructability considerations during the design process. The design-bid-build process is time consuming. And, the low bid typically determines the contractor who will perform the work regardless of qualifications, capabilities, or experience

In today's marketplace, there is an array of other delivery options available to owners that in varying degrees address the drawbacks of the traditional project delivery approach.

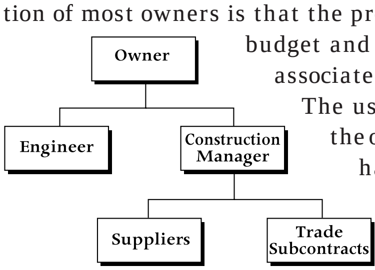
Partnering

Partnering is a concept in which the owner, engineer, and contractor jointly agree to work as a team. Often, partnering is not incorporated as a formal contractual commitment, but rather as an informal agreement usually embodied in a "partnering charter" or similar document. The intent of partnering is to get the team to focus on the objective of the project, to understand each other's goals for the assignment, and to resolve issues as they unfold. The Corps of Engineers and the Business Roundtable were early promoters of partnering, a concept that is now used throughout the United States, primarily for traditionally delivered assignments.

Construction Management

Construction management is similar to the traditional method of project delivery in that all the design documents are prepared and bid to trade subcontractors and suppliers. However, the construction manager replaces the general contractor's function as the overall coordinator of construction.

The construction manager does not take cost or project delivery risks normally taken by a general contractor; these project risks are retained by the owner, although the expectation of most owners is that the project will be constructed on-budget and within the time constraints associated with the project delivery. The usual result is cost savings to the owner over the fee that would have been charged by a general contractor performing a similar function.



Partnering

Normally, the design engineer is either contracted directly by the owner or is under a subcontract as a team member with the construction management firm. If the engineer separately contracts with the owner, it is advantageous to wrap a partnering umbrella around the two firms to form a teaming relationship.

Recognizing the evolution of IPD, many traditional water industry's design consulting engineers are also developing in-house expertise to manage the construction phase of a project to respond to increasing demand. The single point of accountability is appealing to many owners desiring one responsible party for the total delivery of a project.

Construction Management at Risk

The construction-management-at-risk alternative is similar to the construction management option except the construction manager offers guarantees to the owner related to project price, delivery time, and/or overall process performance. In exchange for any or all of these guarantees, the construction manager normally seeks an additional fee to take the risk, and the owner benefits knowing that the project has a construction cost upper limit, that it will be delivered on time, and that the performance requirements of the project wil1 be met and guaranteed.

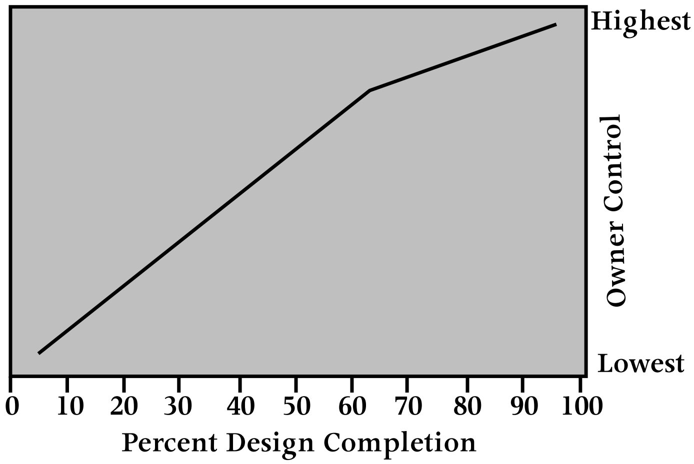
Further, in a traditionally delivered project, minimum standards for the level of quality are established by the contract documents; however, the quality of the finished project may also be influenced by cost in a low-bid environment. With either of the construction management options, the owner is involved in more of the cost decisions affecting the construction process and thus has more control over finished project quality.

With construction management, even though the individual packages are usually bid to prequalified firms, the owner is exposed to the bid results of the individual trade subcontractors and equipment suppliers and vendors. The owner, not the general contractor, in conjunction with the construction manager, then has the flexibility to decide what equipment and material are to be furnished on the project, based on the detailed project cost estimate prepared by the construction manager. This delivery method allows the owner to control the quality of the equipment and materials used on the project.

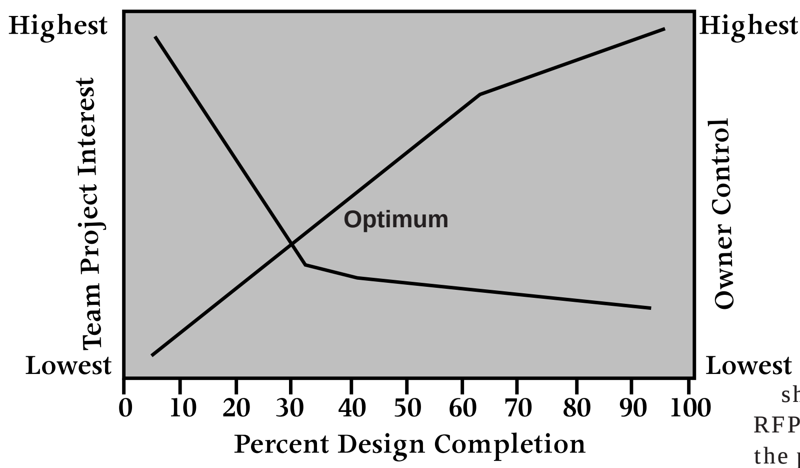
Finally, both construction management options allow the owner to prepurchase equipment in a similar fashion to that used during traditional delivery. Certain "fast-track" options can also be used, if desired, by the owner to reduce project duration. As a general guideline, construction management projects are usually somewhat shorter than traditionally delivered ones.

Design/Build

The design/build option offers the owner the ability to deliver a project rapidly and cost effectively. The first step in a design/build procurement is to prequalify firms that have the capability, qualifications, team, and experience to deliver the project. Concurrent with the prequalification process, the owner prepares a bid package that includes design criteria for the project and a design development document that is approximately 25 to



Owner control and satisfaction as a percent of design completion.



Optimum design/build balances contractor and owner control.

30 percent complete. Bids are solicited from the qualified designer/builders, with the award usually based on the lowest project cost, although there are many other qualitative selection criteria that could be used. Once selected, the designer/builder is charged with implementing the conceptual design over the specified project delivery period. It is generally accepted that negotiated design/build projects are the least litiguous form of project delivery.

For some owners, the design/build concept of project delivery best meets their expectations for the following reasons:

• *Sole source responsibility.* Because the contractor and engineer are operating as a team, one entity is responsible for the delivery and acceptability of the finished project.

• *Cost.* Normally, these projects are the most cost-effective for the owner for several reasons: (1) the delivery time is much faster and administrative and construction costs therefore tend to be less, (2) the design and its related costs should be completed only to the extent required by the designer/builder and permitting agencies, and (3) because 70 to 75 percent of the design details are left up to the designer/builder, the marketplace will provide the owner with the most cost-effective solution that furfills the obligations contained in the request for proposal (RFP).

• *Time.* A traditionally delivered project includes time allocations for the engineer selection process and for a general contractor bid solicitation plus owner and regulatory agency document and approval review periods. Because design/build streamlines, “fast-tracks” and eliminates certain aspects of the traditional delivery process, the overall project implementation period is normally shortened. On most projects, this can shorten the schedule by at least three to six months.

In using this method of delivery, owners must recognize that they will have less control over the outcome of the project than with other methods. If an owner has been continually involved in the development of the design and its associated details, he or she has been in control of the process. Presumably, the contract documents should reflect the specific preferences and requirements of the owner. Obviously, this should leave a relatively comfortable feeling that the documents portray exactly what the owner desires in terms of quality for a project.

RFPs which contain design details developed beyond the 25-30% range can discourage qualified design/build teams from submitting a proposal. The level of project interest of design/build team’s in a RFP increases dramatically when the team can be creative in responding to the goals or criteria associated with the project. A creative environment is usually developed by setting forth project objectives, codes and quality and performance standards and allowing the design/build teams to generate their own unique approach to the project. This objective is achieved when the design is less than 25-30% complete.

The ideal design/build procurement occurs when the designer/builder still has an opportunity to be creative, while the owner maintains some control by developing the design to the 25 to 30-percent stage.

Owners who are not comfortable with the designer/builder defining the remaining 70 to 75 percent of a design should recognize that the concepts originally presented in the RFP can be changed, but these changes will impact costs once the project is underway in much the same manner as changes would affect a traditionally delivered project.

Privatization

Privatization concepts are gaining more appeal as communities and water purveyors deal with fiscal issues. Privatization includes a variety of options ranging from outsourcing specific functions (e.g., sludge hauling, lawn maintenance) to contract operations and full ownership of facilities. For a variety of reasons, a private entity is usually able to deliver a specific service to a municipal water purveyor for a lesser cost and guarantee a prescribed product or outcome.

Currently, more than 500 municipal treatment plants are operated by private contract operations firms. Additionally, thousands of private water companies, large and small, operate within the United States. We will take a look at how IPD is effectively helping two Florida utilities.

Orlando Utilities Commission – Water Project 2000

The Orlando Utilities Commission’s Water Project 2000 was developed to improve water quality, renew and replace infrastructure, and expand capacity to ensure a safe, reliable, and adequate water supply that customers will value and appreciate. The approximately $138 million to $153 million program involves upgrading four existing treatment facilities with the ozone treatment process; constructing two new treatment facilities; constructing critical new transmission pipes; renewing and rehabilitating older distribution mains; and upgrading the supervisory control and data acquisition (SCADA) system controlling OUC’s water facilities. The projects and their estimated capital cost ranges are shown in Table 1.

All the projects included in Water Project 2000 are scheduled to be completed by September 30, 2000. With limited staff to manage each project, and the need to deliver the program expeditiously and cost effectively, OUC embarked on a study to evaluate different IPD delivery methods.

The projects listed in Table 1 can be categorized as either new construction or upgrades/retrofits. The projects within each category have specific needs, but generally involve either construction of entirely new production or transmission and distribution facilities, or upgrades, retrofits, or improvements to existing facilities.

To assist in evaluating the delivery method or methods most appropriate for OUC, a matrix table was developed that incorporated the Water Project 2000 goals. Evaluative criteria were developed and each delivery method rated for each criteria relative to the other methods. No attempt was made to weigh the evaluative criteria on the basis of importance.

The evaluative criteria considered in completing the matrix included:

• Schedule. What is the expected overall duration of the delivery method?

• Total Cost. What is the overall project cost, including design, construction, and potential change orders?

• Quality. What are the expectations regarding the quality of the finished product?

• Owner Control. Will OUC be involved in the process enough to be completely satisfied with the finished product?

• Owner Risk. Will OUC be taking additional risk (e.g., financial, process, design integrity) with the method?

• Management Time. How much of OUC's management time will be consumed with the method?

• Market Conditions. How familiar are the local consulting engineers and contractors with the proposed method?

• Spreading Work. Will the method allow OUC to distribute work to qualified engineers and contractors?

• Performance Guarantee. Does OUC gain any equipment or process performance guarantees with the method?

Tables 2 and 3 present the results of evaluating the delivery methods for the two general categories of OUC projects. The schedule, owner control, owner risk, management time, and performance guarantee ratings are identical for both new construction and upgrade/retrofit projects. Different ratings were selected for total cost, quality, market conditions, and spreading work, depending on the general category of project.

OUC is currently proceeding with three upgrade/retrofit projects utilizing a construction management at risk approach. The Conway, Kirkman and Pine Hills Water Treatment Plant projects are planned to be completed by early 1999. The Lake Highland project will be delivered using a design/build approach beginning in September, 1996. Procurements for the other major projects will be staged and begin in 1997.

Table 1. Water Project 2000 Capital Project Summary.

No	Project Type	Capital Cost Estimate Range[a] (1995 Dollars)	
1.	Conway Plant Upgrade	$17,170,000	$19,078,000
2.	Kirkman Plant Upgrade	$10,348,000	$11,498,000
3.	Pine Hills Plant Upgrade	$7,956,000	$8,840,000
4.	Kuhl Water Plant Upgrade	$11,485,000	$12,761,000
5.	Lake Nona Interim Plant Improvements[b]	$649,000	$721,000
6.	New Southwest Plant Phase 1[b]	$25,207,000	$28,008,000
7.	New Southwest Plant Phase 2	$3,488,000	$3,875,000
8.	New Lake Highiand Plant	$28,836,000	$32,040,000
9.	New Southeast Water Plant	$14,475,000	$16,083,000
10.	Demolition Of Dr. Phillip's Plant	$1,262,000	$1,402,000
11.	SCADA/Instrumentation System Upgrade	$4,490,000	$5,988 ,000
12.	Corrosion Control Improvements[b]	$492,000	$547,000
13.	Transmission & Distribution Projects	$4,973,000	$5,525,000
14.	Distribution System Renewal & Replacement Projects	$6,867,000	$7,630,000
	TOTAL	$137,698,000	$152,996,000

[a]Includes the costs for land, administration, engineering, and construction.
[b]Projects currently under construction.

Table 2. Evaluation of Delivery Methods for Upgrades/Retrofits.

Evaluative Criteria	Traditional Delivery	Constructlon Management	Construction Management at Risk	Design/Build	Relative Ranking Criteria
Schedule	3	2	2	1	1:Shortest
Total Cost	3	2	2	1	1:Lowest
Quality	3	1	1	2	1:Highest
Owner Control	2	1	1	3	1:Highest
Owner Risk	3	3	2	1	1:Lowest
Management Time	3	2	2	1	1:Least
Market Conditions	1	2	2	3	1:Most exp. & No. of Firms
Spreading Work	1	2	2	3	1:Easiest
Performance Guarantee	No	Yes, Equipment Only	Yes, Equipment Only	Yes, Entire Process	

Table 3. Evaluation of Delivery Methods for New Construction.

Evaluative Criteria	Traditional Delivery	Constructlon Management	Construction Management at Risk	Design/Build	Relative Ranking Criteria
Schedule	3	2	2	1	1:Shortest
Total Cost	3	2	2	1	1:Lowest
Quality	2	1	1	3	1:Highest
Owner Control	2	1	1	3	1:Highest
Owner Risk	3	3	2	1	1:Lowest
Manag. Time	3	2	2	1	1:Least
Market Conditions	1	2	2	2	1:Most Firms
Spreading Work	1	2	2	3	1:Easiest
Performance Guarantee	No	Yes, Equipment Only	Yes, Equipment Only	Yes, Entire Process	

United Water Florida

In 1994, United Water Florida (UWF) initiated a study to review the status of seven wastewater treatment facilities in the Jacksonville area. The objective was to identify the needs required at each plant to comply with FDEP and NPDES permits.

The Monterey Wastewater Treatment Facility, the largest of the seven plants at 3 MGD, was selected as the highest priority project. The plant had several deficiencies, and a UWF analysis of future needs indicated that the facility required re-permitting the flow at 3.6 MGD. A review of expansion options was prepared and it was agreed that installation of a new, 3.6-MGD sequencing batch reactor (SBR) plant would be the most cost effective solution.

It was necessary to submit the DEP permit application prior to completing engineering studies of all details, which resulted in the need for additional work addressing permit issues after the submission of the application. Conceptual level scope definition and limited availability of capital made accurate cost estimates and construction schedules very important to UWF.

In an effort to ensure project quality and keep the project as affordable, yet deliver the facility as rapidly as possible, several IPD alternatives were evaluated by UWF staff including design-build and construction management. After careful consideration of each alternative the construction management alternative was selected for the following reasons:

Continuous Cost Information: The design and construction management team developed a detailed construction cost estimate and project schedule very early in the development of the design. These baselines were then utilized to evaluate all options as the design unfolded. This allowed the project team, including UWF staff, to make decisions with full knowledge of the cost and schedule impacts of those decisions, with confidence that the final cost of the project will be within the projections.

Equipment Selection: Proposal requests for the SBR and ultraviolet disinfection equipment system were sent to several prequalified vendors. The resulting proposals were carefully analyzed from a technical, constructability and operations perspective to determine the best value for UWF. UWF staff was able to participate directly in this process and made a selection based upon all factors — not simply the lowest initial cost. In addition, because this equipment was procured early in the design process, designing optional layouts for different vendors was eliminated which resulted in design cost savings.

Schedule: It was important to UWF to complete this project as quickly as possible. The schedule urgency was due to potential performance problems with the existing facility. It is estimated that UWF reduced the overall project delivery by four to six months using the selected delivery method.

Cost: One significant benefit for delivering the project with a construction management approach was that the overhead and profit associated with the administration of the construction, site supervision and check-out and start-up of the facility was approximately 3% of the total construction cost less than that which would be expected for a traditional design-bid-build project.

Integrated Team: Because the owner, engineer, and contractor are working together as a team in the decision-making process, project issues are resolved promptly and with full knowledge of all of the potential project impacts. This partnering arrangement has kept the project on schedule.

Summary

The traditional design-bid-build method of project delivery has inherent drawbacks which is causing owners to look for alternative ways of designing and constructing facilities. Diminished owner monetary and personnel resources, timeliness, performance assurances and quality objectives are all reasons why owners are reaching out for integrated project delivery methods to help them in their day-to-day management of their facilities. As these methods are gaining increasing popularity, they are proving to be techniques which can lower project costs, expedite completion schedules, and ensure owner control of project quality.

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Outsourcing *from Page 27*

3. Willingness to invest in the city utility billing system to improve performance through contributed capital.

Each of the full service firms was asked to address these criteria in supplemental responses. These comments helped formulate Alternative 4 which includes full meter reading, customers services and field services, but not the computer processing. The vendors would to “pay” the city for processing the bills through the current allocation of cost ($89,100). The city retains control of the database.

Alternative 4, coupled with monthly meter reading, saved the city an average of $200,000 per year.

Results and Conclusions

The best interests of the utility are served by having an effective and correct utility billing system. The initial intent was for cost effective services that provide monthly reading of meters; reliable, user-friendly customer service; accurate, customer friendly billing services; and fewer service complaints. In addition, some control over the database was desirable. These goals were realized with the alternative selected. As a result, the city commission authorized its staff to pursue a contract for outsourcing customer service and meter reading services and initiate a 6-month trial period with the selected vendor.

To date the vendor has implemented all the suggestions of the process review team, mostly without realizing the recommendations had previously been made. All meter routes are in the process of being reviewed for efficiency, as are all customer service procedures. Savings to the city, as compared to the city's cost to perform monthly meter reading, will be $200,000 per year over the life of the five year contract.

The city has found that properly implemented outsourcing may improve customer perception, ease employee difficulties, and address long-standing access problems (via demands on the city). The meter reading program contained significant savings for the city over current operations and contributed to overall savings after allocated costs were included in the comparison.

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