Chapter 8

PORTLAND, OREGON'S ALTERNATIVE CONTRACT APPROACH TO TACKLE A COMPLEX UNDERGROUND PROJECT

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ABSTRACT

This paper discusses the process utilized by the City of Portland Oregon's Bureau of Environmental Services (BES) to procure and compensate Impregilo-SA Healy (I/H) for the West Side Willamette River Combined Sewer Overflow (CSO) Project. The contract method is a three-phase process consisting of qualifications based contractor procurement, pre-construction phase design assistance/construction planning, and facility construction where the contractor is compensated on a cost reimbursable-fixed fee basis. The paper focuses on pre-construction phase lessons learned from the development of the contract general conditions, establishment of a construction budget and cost control program, incorporation of contractor recommended design changes, and development of a subcontractor procurement program for construction.

PROGRAM BACKGROUND

In August of 1991, the City's Bureau of Environmental Services (BES) entered into a Stipulated and Final Order (SFO) for combined sewer overflow (CSO) abatement with the Oregon Department of Environmental Quality (DEQ). The agreement requires the City to control 55 combined sewer overflows by December 1, 2011, with intervening major deadlines to complete specific parts of the work. The West Side CSO Project is required to meet the next regulatory milestone of December 1, 2006 and consists of a combination of near surface pipelines, a soft ground tunnel, and

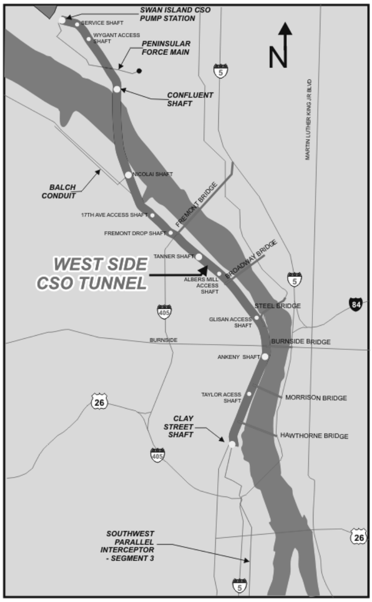

Figure 1. West Side CSO project

pump station that will transport CSO flow from combined sewer areas in west Portland to the City's existing wastewater treatment plant as shown in Figure 1.

CONTRACT DEVELOPMENT PROCESS

The City of Portland standard practice is to use the design-bid-build approach to contracting, as required by Oregon Revised Statutes (ORS) Section 279. The design-bid-build projects constructed under the City's previous CSO milestone were done utilizing partnering, escrowing bid documents, geotechnical baseline reports, differing site conditions clauses, and in some cases, dispute review boards. However, unresolved disputes still led to claims for additional compensation as a result of a number of differing site condition claims. Consequently, with the higher level of construction risk and complexity with the West Side CSO program, BES chose to utilize an alternate contracting structure, modeled after but with significant differences from a construction manager/general contractor (CM/GC) approach. The contract approach was to procure a prime contractor using a qualifications-based process, and establish a contract as cost reimbursable with a fixed fee. The intent was to have a fixed fee (established by proposing contractors during the procurement phase) for the life of the contract that included all contractor off-site and on-site overhead including superintendents and management staff, general conditions costs, and profit as shown in Figure 2. Labor, equipment, and materials are paid on a cost-reimbursable basis. Subcontracts are competitively bid based on lump sum or unit price and paid accordingly. The significant differences with CM/GC contracts researched by BES is that the prime contractor would not be limited in the amount of work to be self-performed (on the contrary, BES wanted to know who would be doing the tunnel and shaft work) and there would be an estimated reimbursable cost developed rather than a guaranteed maximum price (GMP).

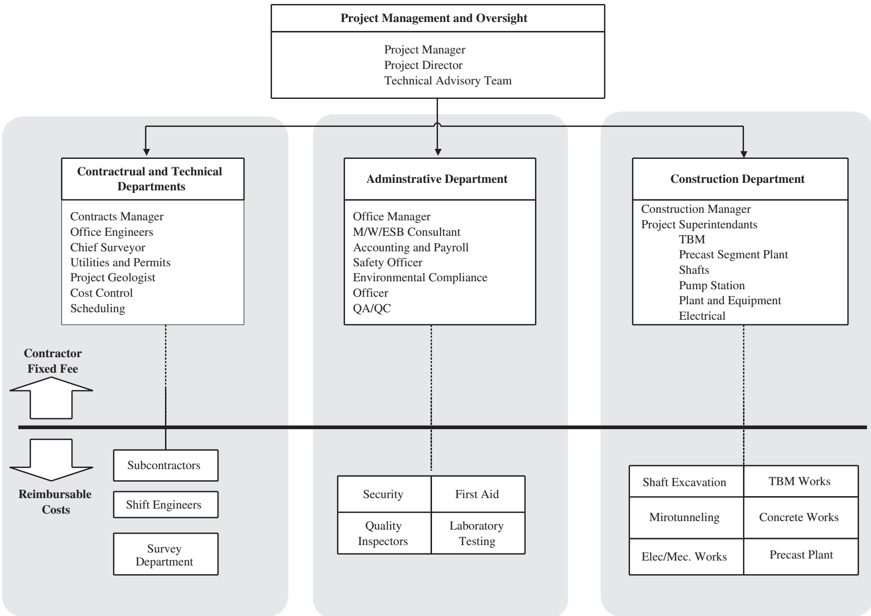

Figure 2. Project organizational chart—fixed fee versus reimbursable costs

CONTRACTOR PROCUREMENT PHASE

Oregon contracting law, governed through Oregon Revised Statute (ORS) 279, requires that all public improvement projects be procured by competitive bid. However, ORS 279.015 allows an exemption to this process providing it can be shown the proposed contracting process would not diminish competition nor encourage favoritism, and would results in cost savings for the project.

The exemption sought for this project required a Findings of Fact, a 14-day public review period, and a public hearing before the local contracting board, in our case the Portland City Council. Upon City Council approval, BES proceeded with the development of a qualifications-based contractor selection package. The process was modeled after the City's two-step selection process for Professional, Technical and Expert (PTE) Services that requires interested parties to respond to a Statement of Qualifications (SOQ) followed by a Request For Proposal (RFP)

A key element of this process was providing qualified candidates a forum to demonstrate their understanding of the project and highlight their skills and experience solving project specific issues. During the process each contracting team was provided a three-hour pre-proposal interview. The meetings provided an opportunity for each contractor to ask BES project related questions, in confidence, that would assist in the development of their proposal. Questions that highlighted errors or required clarifications to the proposal and/or contract documents were addressed in addenda issued by BES. The informational meetings proved to be crucial in further development of the contract's general conditions, since that was the area with the greatest number of questions from the three prequalified contractor teams.

PRE-CONSTRUCTION SERVICES PHASE

Following contractor selection, a pre-construction services contract was executed with Impregilo-SA Healy (I/H), the selected contractor. The first step of the pre-construction phase was to integrate I/H into the project team. During this phase I/H's primary objectives were to provide a review of the design focusing on constructability, perform value engineering and risk assessment, develop an estimated reimbursable cost for construction, and jointly develop a final set of general contract provisions for the contract.

Owner-Contractor Working Arrangements

I/H entered into a five-month-long contract for pre-construction services that was eventually extended an additional three months. I/H physically moved into the existing project office with BES, the designer Parsons Brinckerhoff (PB) and the construction management staff Jacobs Associates (JA). Co-location of staff allowed direct communication between all parties. During the kick-off meeting, key technical and contractual issues were identified and task forces consisting of BES, I/H, PB, and JA staff were assigned to each one. The issues were prioritized based on schedule considerations with all issues to be resolved by the end of the pre-construction services phase.

Design Assistance

At the time of contractor selection, the design documents for the facilities were at different stages of completion. The tunnel and associated pipelines were approximately 85 percent complete, whereas the pump station was only 50 percent complete. A milestone progress printing of the contract documents was made that included drawings, specifications and geotechnical reports. During the first month of the pre-construction phase, the contractor was responsible for reviewing each element of the design and making recommendations to the designer in an effort to reduce construction costs and improve schedule. A technical review meeting at the end of the first month identified possible design changes. Each suggested change was recorded, discussed, and, where possible, accepted or rejected. Some ideas required additional assessment and evaluation and were later incorporated into the design. The more significant design changes initially made were:

- Relocation of the primary tunnel mining location
- Modification of the south tunnel segment configurations (use of a zigzag taper pattern)
- Increase in the south tunnel segment length from 1.3 to 1.6 meters
- The addition of a used TBM for the north tunnel drive
- Increase in the internal diameter of the mining shaft from 13 to 17 meters

During the initial design review phase, the cost estimators worked to establish their methods of cost reporting and the work breakdown structures. The challenge for the cost estimators at the end of the first month was being able to have and use a set of drawings that included the most recent changes.

For the designer, the task of incorporating changes required a number of logical steps. Calculations were needed to support the changes, and therefore many drawings/details lagged behind "accepted" concept drawings. The basic design itself was proceeding forward, so most additional changes had a ripple effect throughout the drawings. In an effort to support the cost estimating and stay current with proposed changes, constant review and revision was necessary. This continuous "value engineering" made it a challenge for the designer to balance project staffing with project schedule requirements and design budgets.

During this phase of the design process the owner and contractor had to interact very closely. This resulted in some drawings being "customized" for different users. For example, the cost estimators required that the drawings be fixed for estimating purposes and that all subsequent changes be recorded for updating the estimate at a later date. The contractor needed the completion of selected drawings in advance of final design completion for early subcontracting bidding packages. Accommodating these types of project needs produced an additional level of complexity for the designer to responsively incorporate and track design changes as well as complete the final design documents on schedule.

Constructability Reviews

A key advantage of this contracting method is having the contractor on the project to perform constructability reviews prior to design completion. In addition to the design changes outlined above, the contractor provided significant feedback during the design of the pump station. The combination of anticipated construction cost and contractor means and methods directly influenced the lining and slab designs, allowing for construction openings to remove formwork and provide for rational pour sequences. Contractor evaluations of top-down versus bottom-up shaft construction also resulted in significant design changes and risk reductions. Constructability reviews of the micro-tunneling operations resulted in the relocation and elimination of jacking and receiving shafts. As part of this effort, the contractor and BES met with the public to address local concerns and discuss preferred means and methods for construction. As a result, the contractor was able to layout workspaces based on available equipment and establish traffic controls specific to their needs.

Risk Assessment

A shared risk assessment was developed for the project as part of the first technical review meeting. Identified risks were discussed within technical groups and evaluated in terms of their expected severity and likelihood of occurrence. Each risk was rated and prioritized. The outcome of the risk assessment resulted in (1) modifications to the facility designs and/or construction means and methods to mitigate specific risks and (2) the establishment of a project contingency for those risks that could either not be easily mitigated or were thought to have a reasonably low likelihood of occurrence.

Tunnel Boring Machine (TBM) Procurement

Procurement of the TBM for this project was important for two reasons (1) excavation and lining of the tunnel is a construction schedule critical path item, and (2) the difficult geologic conditions required highly specialized equipment. Early interaction between the contractor, owner and designer allowed technical details to be discussed and worked out so that both parties agreed on the type of TBM best suited for the geologic conditions. This agreement allowed the contractor to prepare an equipment procurement package for the TBM and to receive proposals from various qualified manufacturers. This procurement process allowed BES, PB and I/H to select a TBM best suited for the project conditions and allowed the manufacturer to begin machine design early. In addition, I/H was able to negotiate for two machines—one new and one refurbished. As a result of this process, the machines will be available eight months after issuance of I/H's notice to proceed with construction, instead of the 12-month period typically associated with TBM procurement.

Geotechnical Baseline Report

I/H provided technical review of the Geotechnical Baseline Report (GBR) during the later stages of development. I/H assisted in establishing baseline values for the geotechnical conditions and actively participated in writing the chapter on anticipated ground behavior. The purpose for this was two-fold. First, the cost estimators used the GBR as one of the primary tools to establish the estimated reimbursable cost. Second, I/H had to be comfortable with the information provided in the GBR when administering subcontracts for ground improvement and microtunnel work.

Estimated Reimbursable Cost (ERC) Development and Cost Control Program

I/H was required to produce an ERC for the project within 90 days of receiving the Notice to Proceed. Concurrent with this effort, BES estimating staff would develop an ERC for comparative purposes. The goal of the ERC was to provide a baseline for development of the project budget and for cash flow planning by BES. The intent was to establish a reasonable construction cost without contingencies to cover unknown factors. These factors were considered in the risk analyses and were apportioned in the budget as a separate contingency and risk amount. Several portions of the design were not 100% complete at the time of ERC development and therefore were estimated as budgetary "plug" amounts. As described earlier, the ERC includes all labor, materials, and equipment necessary to perform the construction work. The ERC, together with the Fixed Fee, would then become the construction contract amount.

The amount of work covered by the ERC required BES and I/H to establish common estimating procedures during the initial stages of the work. The first step was to agree on common work breakdown structure for the estimate. As shown in Table 1, the ERC was structured using nine major categories. Once agreement on the work breakdown structure was complete estimating began. During the estimating process regular meetings were held between BES and I/H to compare material quantities and resolve differences. The estimated costs were then developed based on common labor and equipment rates.

At the completion of the initial 90 days, a comparison of the BES and I/H ERC's was performed. The two estimates were within 10% of each other, and after a joint comparison, a baseline project cost, including both the fixed fee and the ERC, of $318 million was developed.

Since there was a large difference between the November 2001 Engineer's Estimate of $253 million and this estimated cost, an extensive examination of the Engineer's Estimate and the ERC was performed. The joint estimating team developed a list of a thirty-nine cost elements, a portion of which are shown in Table 2, that were to be thoroughly evaluated for design, constructability, and reduction of scope or outright elimination. The evaluation effort took place from April 2002 through June 2002. After a long series of evaluations, including a major redesign of the pump station structure, elimination of a service shaft, and elimination and/or deferral of several minor project elements, a final estimate was developed and the final contract amount of $293 million was agreed upon and presented to City Council for approval.

Cost Control Program

The pre-construction phase scope required I/H, to develop and provide to the owner, a program to accurately track, control, and forecast costs. BES felt it important that the contractor implement a program that they had utilized on past successful projects. The system provided by I/H tracks the actual costs against the budget and makes projections based upon learned history. The project cost control program

Table 1. Work breakdown structure categories

No.	Item	Description
1000	Mobilization / General Conditions	General mobilization for construction and the General Conditions requirements of the specifications.
2000	Main Tunnel	North and South Tunnel Drives, Segment Fabrication, TBM Procurement
3000	Pump Station	Excavation and Support for Pump Station; Pump Station Structure; Mechanical Electrical; Service Buildings
4000	Main Tunnel Shafts	Slurry Wall Shafts—Confluent, Nicolai, Upshur, Ankeny, Clay Street; Drilled Shafts—Albers Mill
5000	South West Parallel Interceptor, Segment 3	Shafts, Utility Relocations, Microtunnels, Pipe Jacking
6000	Peninsular Force Main	Force main construction and connecting pipelines
7000	Ground Improvement for Bridges	Jet Grouting for bridge structure settlement protection.
8000	Instrumentation	Geotechnical ground and structure monitoring; SCADA Control system
9000	Indirect Costs	All costs not directly chargeable to a specific construction item.

includes a series of BES checks and balances such as review and approval of all subcontracts and subcontract modifications, periodic field audits of contractor activity, review and approval of all purchases over $50,000. Additionally, BES staff conducts biweekly audits of cost reimbursement requests (payment applications) and construction schedules prior to releasing payments.

Subcontracting Plan

The general contract conditions require that all subcontracts be procured on a competitive basis. Because the project will occur over a four year construction period, and contains diverse work opportunities beyond what the prime contractor will self-perform, BES required I/H to develop a subcontracting plan that clearly described the process to be used for advertising and procuring subcontractors. I/H identified three main divisions of subcontracting work: (1) specialty work (work which is rarely done in Portland and that only a limited number of contractors perform, e.g., slurry walls, ground improvement, microtunneling, etc.), (2) all subcontracting work that can be performed by local Minority/Women/and Emerging Small Businesses (M/W/ESB), and (3) all other work which can be performed by the local contracting community. The method of advertisement and procurement was indicated for each type of subcontracting, including outreach methods proposed for M/W/ESB firms. A model procurement document was reviewed and approved by BES prior to the first advertisement for subcontracting, and all procurement results are provided to BES prior to award of a subcontract. Copies of all subcontracts are then provided to BES prior to issuance of notice-to-proceed for each subcontract.

As part of the outreach plan for M/W/ESB firms, a breakdown of all project activities which can be performed by M/W/ESB contractors was developed for each work location, along with a subcontract cost range, approximate time when needed, and whether the work would be done by a first or second tier subcontractor. Periodic public forums and project web-sites are used to advertise upcoming subcontracting opportunities available to the local contracting community.

Table 2. Estimated reimbursable cost reduction item examples

No.	Recommendation	Action	Add or (Deduct) Amount from ERC
1	Delete Albers Mill Shaft	Approved	$(1,190,411)
2	Reduce capacity of SIPS elevator	Approved	$(40,000)
3	Eliminate Generator Building	Not eliminated at this point in time. Explore second power feed to replace generators	No cost reduction
4	Replace 2 part tunnel lining backfill grout with 1 part grouting system	Rejected -State-of-the-art Grout program, recommended by I/H and design team.	No cost reduction.
5	Reduce Jet Grout Plug Thickness	Partially Approved	$(78,494)
6	Reduce the Shafts Wall Thickness'	Current walls could be conservative	See Item 11
7	Reduce the Security requirements	Approved	$(361,047)
8	Defer Mechanical and Electrical equipment in SIPS required for future Eastside Tunnel.	Approved	$(5,100,000)
9	Remove Mill and Jefferson Conduits from project.	Approved—Deferred for future contracts.	$(2,023,920)
10	Minimize work for Balch Connector. Required for 2011 CSO order, but not the 2006 order, can be deferred; build connection from Nicolai to the street	Approved	$(7,284,000)
11	Minimize Shaft Diameters	Approved—Includes SIPS pump Station reduction.	$(3,899,522)
12	Review / Reduce Reinforcing Requirement for Tunnel Segments	Approved.	$(220,686)

Equipment Purchase

Equipment costs, especially tunnel boring machines, are a significant project expense. The method and timing of equipment payment has a major impact on the project cash flow. The comparative costs and benefits of new equipment with warranty, versus used equipment must also be weighted. An equipment schedule and cost analysis was developed to determine when each piece of major equipment would be needed on the job-site, new versus used benefits, the term it was needed, and the earliest date it could be removed. This information was used to determine whether it was more cost-effective to purchase, lease, or bring in equipment from other areas. Whether purchasing or leasing equipment, I/H obtains at least three quotes that are reviewed by BES prior to authorizing a purchase. The cost analysis also includes resale or salvage value.

Contract General Conditions

Under this cost-reimbursable/fixed fee contract, BES accepts the risk of Type I differing site conditions (those conditions differing materially from those indicated in the contract), since I/H will be paid directly for the cost of mitigating whatever conditions are encountered. However, anything that could significantly affect the critical path of the schedule beyond what I/H has the ability to make up prior to contract completion (which the owner would also pay for as overtime) can have an effect on the contractor's fee. Consequently, the general conditions of the contract reference a differing site condition (DSC) for the prime contractor only if an unknown physical condition is encountered of an unusual nature differing materially from that normally encountered as inherent in the character of the work (Type II), and it affects the schedule's critical path by a period of at least seven days. In that case, the contractor is awarded additional contract time and an increase in fee. The fee is determined by dividing the fee by the number of weeks in the contract and applying this "weekly fee" to each week of delay.

Since subcontractors will have lump sum or unit price subcontracts, a separate clause is included in the general conditions that is more typical of DSC clauses, recognizing both Type I and II DSC's for subcontractors. Consequently, subcontract claims will be handled as in any lump sum contract with a DSC clause. The contractor is then reimbursed for the agreed additional subcontractor costs, including subcontractor markup. The prime contractor is entitled to an additional fee *only* if the additional subcontractor work results in an increase in overall contract time.

Extra Work, which is defined as an item of work not provided for in the contract but ordered in writing by the owner as desirable for optimal completion of the contract, will also increase the fee by an amount determined by multiplying the reimbursable cost of the extra work by the ratio of the initial fee to the original ERC. BES makes progress payments on a bi-weekly basis. Compensation is based on the amount of documented reimbursable costs, plus a fee payment that is based on a percent of the fixed fee equal to the percent of work complete.

CONCLUSIONS

There is not one cure-all contract method for underground projects. Rather, the type of contracting approach utilized should be tailored to specific project circumstances. The City of Portland was fortunate to have the legislative ability and political will to try an alternative to Design-Bid-Build. Only time will judge the suitability of this contract approach for this project. No matter what the specific method used, it has proven to be a significant benefit to work directly with the contractor prior to design completion. The schedule savings, along with the opportunity for design review, value engineering, and joint risk analysis has already resulted in significant cost savings to the project. Task forces consisting of members of BES, PB, JA, and I/H staff, used to address issues, resulted in buy-in of all the parties to problem solutions. A strong partnership atmosphere was also created through the shared office space and the joint effort in moving the project into the construction phase.

Use of this contracting alternative has not been without its share of difficulties. The initial five-month contract for pre-construction services had insufficient time to complete the work, specifically the development of the ERC. Subsequently the pre-construction services contract had to be extended three months to complete the work. Additionally there has been a period of adjustment in that neither BES nor I/H are used to authorization by an owner prior to proceeding with equipment and material purchases, and subcontract execution.

Success of this approach will not be judged solely on the final project cost, but rather will ultimately be measured by our ability to meet the stipulated completion date, by our ability to continually control and forecast accurate project costs, by the number of contracts and dollars delivered to local and M/W/ESB firms, and ultimately by our ability to complete the project without litigation.