

# PORTLAND, OREGON'S ALTERNATIVE CONTRACT APPROACH—A FINAL SUMMARY

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## ABSTRACT

Portland, Oregon's \$370 million West Side Combined Sewer Overflow Tunnel Project has completed the final phase of construction and commissioning. The construction contract, which began in September 2002, was a reimbursable cost plus fixed fee contract that followed a qualifications-based contractor procurement process and a pre-construction planning phase. This paper addresses the final results of the contracting method and provides a lessons-learned case history. Specific items addressed include the benefits realized from the contracting method, areas of improvement, final costs compared to the original contract estimates, design changes and schedule impacts, and subcontract management issues.

## PROGRAM BACKGROUND

In August of 1991, the City's Bureau of Environmental Services (BES) entered into a Stipulation and Final Order (SFO) for combined sewer overflow (CSO) abatement with the Oregon Department of Environmental Quality (DEQ). The agreement required the City to control 55 combined sewer outfalls by December 1, 2011, with intervening major deadlines to complete specific parts of the work. The West Side CSO Project was required to meet the regulatory milestone of December 1, 2006 for control of outfalls along the west side of the Willamette River. The project consisted of a combination of near surface pipelines, a 5.5 km (18,180 feet) long 4.3 m (14 feet) diameter soft ground tunnel, and a pump station that transports 832 million liters per day (220 MGD) of CSO flow from combined sewer areas in west Portland to the City's existing wastewater treatment plant as shown in Figure 1.

## CONTRACT DEVELOPMENT AND CONTRACTOR PROCUREMENT PROCESS

BES utilized a Cost Reimbursable Fixed Fee Contract (CRFF), loosely modeled on a construction manager/general contractor (CM/GC) approach. The contractor selection process was modeled after the City's selection process for Professional, Technical and Expert Services that requires interested parties to respond to a Request for Qualifications followed by a Request For Proposal (RFP) and subsequent interview.

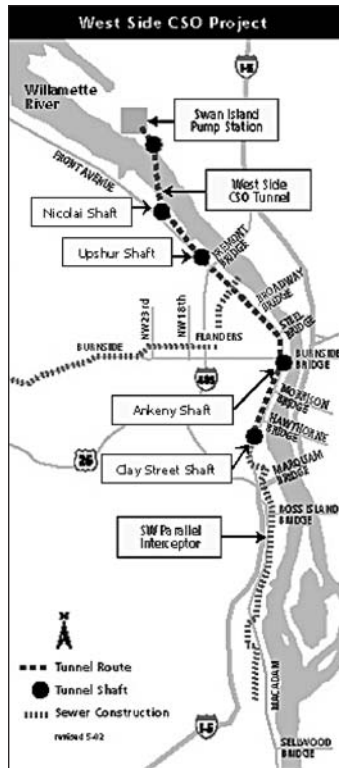


Figure 1. WSCSO project map

Under this approach, the prime contractor was selected using a qualifications-based process that considered project personnel, project approach, subcontracting approach, partnership, safety, Minority/Women/and Emerging Small Businesses (M/W/ESB) practices and a fixed fee. The fixed fee (established by proposing contractors during the procurement phase) was applied over the life of the contract and included all contractor off-site and on-site overhead including management staff, general conditions costs, equipment insurance and profit. Labor, equipment, and materials were paid on a cost-reimbursable basis. Subcontracts were procured using a competitive process and reimbursed on lump sum or unit price basis.

As is explained below, the contract was executed in two parts, a pre-construction planning phase and a construction contract. Notice-to-Proceed for the pre-construction planning phase was issued in January 2002 and ended in August 2002. Notice-to-Proceed for the construction contract was issued on September 12, 2002 with an original completion date of August 12, 2006 (47 month contract period). This date was extended to October 1, 2006 and Substantial Completion was achieved on September 14, 2006, well within the stipulated SFO milestone date of December 1, 2006.

The original construction contract amount was \$293,060,874 in 2002 dollars, which was divided into two main parts: a fixed fee of \$58,702,000 and an estimated reimbursable cost (ERC) of \$234,358,874. In addition to the contract amount, a contingency of \$17 million was carried equivalent to 6% of the contract amount based on a

joint risk analysis (discussed below) performed during the pre-construction phase. The construction budget in 2002 dollars with contingency was \$310 million.

### **PRE-CONSTRUCTION SERVICES PHASE**

Following contractor selection, and prior to executing a construction contract, a five-month pre-construction services consultant contract was executed with Impregilo/SA Healy Joint Venture (IHJV), the selected contractor. IHJV physically moved into the existing project office with BES, the lead designer Parsons Brinckerhoff (PB) and the construction management staff of Jacobs Associates (JA). During this phase IHJV's primary objectives were to provide a review of the design (which was overall about 75% complete) focusing on constructability, perform value engineering and a joint project risk assessment, develop the ERC for construction, a cost-loaded schedule, and assist BES in producing a final set of general contract provisions for the construction contract. This effort resulted in a large advantage to BES in that a realistic construction budget was set and several features of the design were changed to make the project more practical from a constructability standpoint. The most significant change made during this period was the re-design of the lower pump station outer walls. The initial design concept for the walls separated the final structure from the concrete slurry walls. This resulted in concrete wall thicknesses of up to 2.7 meters (nine feet) in the lower portion of the pump station at a depth of 49 meters (160 feet). Based on IHJV's concern with the pre-cooling and post-cooling required to keep the heat of hydration of the concrete to a manageable level, the lower walls were redesigned as a composite wall with the pump station slurry walls. This resulted in a 0.9 meter (three foot) reduction in the wall thickness with a corresponding direct cost savings as well as significantly reducing the potential for a large defective specification claim.

Based on the previous example and a number of other suggested design changes, it became apparent that the original five-month duration of the pre-construction phase was insufficient. Activities that were thought to be concurrent actually were sequential. Cost-saving ideas by IHJV had to be reviewed by PB and BES. When acceptable, design drawings were changed, new cost estimates for that item of work were developed, and the new estimate then became a revision to the ERC. As a result, three additional months had to be added to the pre-construction phase of the work. For a project of this size, a nine to ten month pre-construction phase (begun no later than the 60% design stage) would have been preferable.

### **CONSTRUCTION CONTRACT**

The \$293,060,874 CRFF construction contract utilized by BES shared and distributed project risk in several non-traditional ways. Several of the key risk-sharing provisions are discussed below:

- **Contractor Fixed Fee**—Guarantees contractor's profit provided project is completed within allotted time.
- **Differing Site Conditions Clause**—Type I differing site conditions (DSC) are not recognized for the prime contractor's work, since cost reimbursement is already occurring. However, if a Type II DSC is encountered, and it affects the schedule's critical path by a period of at least seven days, additional fee and time is allowed. Since subcontractors are compensated through lump sum or unit price subcontracts, a standard DSC clause recognizing both Type I and II DSC's is included in the contract for subcontractors.

- Compensation—The contractor is reimbursed twice a month for 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.
- Subcontracting—Subcontracts were competitively bid as needed during the course of the contract by IHJV, rather than having subcontractors selected in advance. The pluses and minuses of this are discussed further on in this paper

At the time the construction contract Notice-to-Proceed (NTP) was issued, the tunnel design was 100% complete and the pump station design was approximately 80% complete. As previously stated, the NTP was issued in September 2002. However, the final pump station drawings were eventually issued in February 2003, five months after the original construction NTP. Consequently, from an Owner perspective, the contracting approach saved approximately ten months of schedule (September 2002 to July 2003) prior to the start of construction.

### RISK ASSESSMENT AND OUTCOME

A formal risk assessment workshop was held during the pre-construction phase. A professional facilitator was engaged, and team members from the Owner, Design Engineer, Contractor, Construction Manager, and the City's advisory board were included in the workshop. During the workshop, a total of 251 risks were identified for the categories of work:

Access/Permit Risks	35
Tunnel Construction Risks	47
Ground Improvement Construction Risks	58
Shaft Construction Risks	25
Pump Station Construction Risks	20
Microtunneling Construction Risks	33
Completion/Startup/Operation/Maintenance Risks	10
Financial/Other Risks	23
<b>Total Identified Risks</b>	<b>251</b>

These risks were each assigned a value of potential cost impact and probability of occurrence, each being scored over a range of 1 to 5, with 5 indicating the highest level of cost impact and the highest probability of occurrence. The two factors were then multiplied and a risk matrix was developed with resultant scores of 1 to 25.

Upon rating the various identified risks, a series of risk mitigation proposals were developed to reduce risk to the project during the pre-construction phase. Methods of mitigation included revisions to the design and the contract documents, additional geotechnical investigation or instrumentation, and development of a subcontracting plan that addressed packaging of subcontracts and management of subcontractor claims and disputes. In addition, the Access/Permit and Financial/Other risks were managed by including the potential costs in the Estimated Reimbursable Cost.

For those risks that could not be entirely mitigated or priced, a contingency allowance was developed and approved by the City Council along with the construction contract. This was done by evaluating each category of risk and estimating a total amount expected to be expended if the risk event were to occur (approximately \$34 million). The

**Table 1. Contingency versus actual expenditures**

#	Item	Contingency Allowance	Actual Cost Difference from Estimated
1	Access/Permit Risks	—	—
2	Tunnel Construction Risks	\$18,420,000	\$(380,000)
3	Ground Improvement Construction Risks	1,447,880	5,720,000
4	Shaft Construction Risks	7,305,000	2,325,000
5	Pump Station Construction Risks	2,000,000	3,280,000
6	Microtunneling Construction Risks	2,400,000	10,700,000
7	Completion/Start Up/Operation/Maintenance Risks	2,500,000	
	Reimbursable indirect costs		(6,100,000)
	Accumulative total risk allocation	\$68,145,761	
	Evaluated Risk Contingency (50%)	\$17 million	
	Total Escalation	\$14.5 million	\$15.3 million
	Total Contingency and Actual Cost Difference	\$31.5 million	\$15.5 million
	Amount project is under budget (escalated)		(\$16 million)

total of these estimated items were then evaluated using two statistical models, a 'Monte Carlo' model and an evaluation of the range of risk with probability of it occurring. Both of these statistical methods arrived at the same result, the amount of contingency to reserve would be 50% of the total estimated risks. The contingency amount, about \$17 million, represented just under 6% of the construction contract value.

We compared the estimated contingency developed from the risk register with the actual unforeseen events during the project. This is shown in Table 1.

The result is that the method of contingency calculation nearly matched the actual additional costs incurred, \$17 million estimated compared to the actual of \$15.5 million. We have also shown, in Table 1, the estimated escalation prepared at the beginning of the project, which was \$14.5 million. The actual escalation experienced was \$15.3 million. Combining both the escalation and the contingency, the project came in <\$16 million> under the original budget amount.

### SUBCONTRACTING ISSUES AND PRACTICE

Subcontractor costs were reimbursable to the prime contractor at face value. The general contract conditions required that all subcontracts be procured on a competitive basis, that they be approved by the Owner, and that they be paid as lump sum or unit price. Because the Project design and the Project means and methods were not completely defined at the time of Notice-to-Proceed (NTP), and due to the length and size of the Project, subcontractors were procured as they were needed, rather than all subcontracts being procured upfront. There were advantages and disadvantages to this. First, additional opportunities for minority, women, and emerging small businesses continued to be made available during the course of the contract. Subcontractors did not have to price their work out several years in advance, allowing for subcontracting pricing with less risk contingency. All potential subcontractors got a shot at the work. Competitive pricing was obtained, providing cost benefits to the Owner. Disadvantages: (1) the prime contractor was not able to have any subcontractor identified at the time of NTP

thus slowing initial start-up work; (2) unlike a traditional design-bid-build contract, the project budget established for many areas of work performed by subcontractors was based upon estimates instead of subcontractor bids or supplier quotes, with potential growth in the overall project cost as subcontracts were identified; (3) it was difficult to procure subcontractors for work that was not clearly defined, due to the requirement for lump sum or unit priced contracts; and (4) the prime contractor had to create and employ a sometimes lengthy and cumbersome process to ensure competition, public acceptance, and the Owner's approval. As a consequence of this latter point, the prime contractor did not have the latitude to select subcontractors he was familiar with based on his past experiences, and often there was only one or two quotations.

Subcontract costs in excess of the subcontract amount were only reimbursable if the increase was due to a differing site condition, the subcontractor performed extra work as directed by the Owner, or there was an increase in quantities for unit price pay items. The general conditions were later revised to allow increases in subcontract due to adding work, with the Owner's approval, that had been intended to be self-performed or performed by another subcontractor. All increases in subcontract amount required approval of the Owner.

As for the prime contractor, his Fixed Fee does not change as a result of changes to a subcontract, unless all three of these conditions apply: the subcontractor encounters a differing site condition, the contractor paid the subcontractor, and the additional work resulted in an increase in time of the overall project schedule. The prime contractor receives no other markup on subcontractor changes.

In most cases, everything works according to plan. Changes occurred, change orders were proposed and approved and issued to the subcontractor, and the subcontractors were paid. On a project of this size, very few subcontractors affect the critical path, so the Fixed Fee was not adjusted.

In one case, however, the contract team was severely tested, and the success of the Project was at risk. The pump station, 41 meters (135 feet) in diameter and 49 meters (160 feet) deep, was to be constructed in a shaft supported by 61 meters (200 feet) deep diaphragm walls. A groundwater cutoff was to be constructed with a jet grout curtain from the bottom of the diaphragm walls to bedrock at depth of 101 meters (330 feet). After the primary curtain was grouted, measured inflows exceeded the allowable amount. A secondary curtain was installed, followed by two rounds of remedial grouting. Still, the pump tests were showing inflows in excess of the allowable amount. And, by now, the schedule had slipped by eight months. A differing site condition was claimed by the subcontractor. It was not certain that water could be cut off enough to build the Pump Station.

Additional grouting could be required. Large differing site condition costs could be incurred. The schedule could slip further. Perhaps the pump station would have to be redesigned or even not built. Because of the contract approach and the partnership of the team, alternatives and solutions were openly discussed between Owner and prime. It was decided to install four large dewatering wells and begin excavation. A partial redesign of the pump station would move the Operations Building from the top of the shaft to an adjacent building, allowing concurrent construction. Schedule analysis showed a savings of at least four months from this redesign. Excavation took two months less than scheduled. The initial concrete work completed the recovery of the lost schedule time. The differing site condition was not accepted, but the subcontractor's issues were addressed and an amicable agreement was reached.

The outcome could have been very different. The Owner could have been inflexible on the specified water inflows, or refused to redesign the pump station. Unknown, but large amounts of, expensive grout could have been ordered, adding a minimum of three months of further delay. At these depths, the delays could even be much more. The sub-

contractor could have refused to perform further without a huge change order. The prime could have pushed the differing site condition and earned a large additional fee, but damaged the partnership and ensured a late Project. In the end, each member of the team assumed its risk and the Project came first. The contractor assumed its risk of time and got back on schedule. The Owner assumed its risk of cost and rightly decided that it would cost less to proceed with some uncertainty than to eliminate all uncertainty up front. And the subcontractor was paid for his efforts and relieved of excess risk.

**CONTRACT COST**

The cost tracking system utilized by both IHJV and BES tracked the actual costs for each item of work against the ERC budget for that item as the cost was incurred. Semi-annual estimate-at-completion cost projections were performed based upon learned history. The project cost control program included 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, and biweekly reviews of cost reimbursement requests (payment applications) and construction schedules prior to releasing payments.

The breakdown of the original ERC budget in 2002 dollars versus actual payments as of November 2006 is shown below:

<b>Description</b>	<b>Estimated Reimbursable Cost (2002)</b>	<b>Actual Reimbursed Cost (2006)</b>
Main Tunnel	\$56,426,113	\$56,038,197
Nicolai Shaft	12,494,294	14,021,055
Clay Street Shaft	8,947,244	9,437,201
Ankeny Shaft	7,434,986	7,619,932
Upshur Shaft	8,143,753	6,558,632
Confluent Shaft	9,065,632	10,591,933
Swan Island Pump Station	59,901,514	71,557,760
Pipelines	25,826,435	35,838,060
Indirects	15,289,078	8,577,790
Plant and Equipment	30,829,825	28,157,015
<b>Totals</b>	<b>\$234,358,874</b>	<b>\$248,397,575</b>

The system was tested through an external independent audit in November 2004. The findings of the audit included the discovery of a minor number of double billings which were offset by some items which were found to be unbilled by IHJV. Overall, the audit was highly complementary of the IHJV cost tracking system and the overall project management of the contract by both parties.

**CHANGE ORDERS, CONSTRUCTION CHANGE DIRECTIVES AND VALUE ENGINEERING**

The CRFF delivery method is unique in the area of change management and value engineering. Change orders under this contract are issued only for changes to the General Conditions, an extension of contract time or an increase of contractor

Fixed Fee. There were nine change orders to the prime contract over the four-year contract term. Only one increased the fee due to extra work requested by BES, adding a 115 kV substation originally planned for installation by Portland General Electric. This high-voltage substation was incorporated within the original budget and schedule parameters of the project. Two other change orders added non-compensable time to the contract. The remaining change orders were issued to improve or clarify clauses in the General Conditions with no impact to contract cost or time.

The primary mechanism for change in the contract was the Construction Change Directive (CCD). CCD's were issued to direct changes in the design, changes based upon RFI clarifications, changes resulting from value engineering, and changes due to field conditions. The contract allowed for the rapid implementation of changed work that was self-performed by IHJV because there was no negotiation of cost, overhead or profit since the contractor is simply reimbursed for all direct costs associated with the change. However, for changed work performed by a subcontractor, the process was the same as under a lump sum contract, other than there being no prime contractor markup.

There were a total of 164 CCD's issued on the project, most involving changes to subcontracts, especially the pump station mechanical and electrical work, which was all subcontracted work. In addition, there were 326 subcontract amendments issued involving a total of 200 subcontracts. This was an area of some management difficulty, since although the Owner was required to approve all subcontract amendments in advance, in practice, some of the subcontractor extra work was authorized verbally with the actual subcontract amendment issued long after the work had been performed.

## **RECOMMENDED CHANGES TO CONTRACT LANGUAGE**

Like most delivery methods, refinements in the contract provisions can be made. Some suggestions from both IHJV and BES perspective are provided below.

### **IHJV Recommendations**

The contract language relative to subcontracting can be confusing. The prime contractor is working under a Reimbursable Cost plus Fixed Fee arrangement and the general conditions are geared toward that. Subcontractors, on the other hand, work under conventional fixed price contracts. Primes generally include flowdown clauses in subcontracts, tying subcontractors to the prime contract. This clause is used because the contractor does not want to miss any requirements that the Owner wants to specifically impose on subcontractors, such as prevailing wages, insurance requirements, etc, as well as a host of job-specific requirements. When a subcontractor reads these general conditions, substituting himself for "Contractor," his responsibilities and duties may not be clear. For example, if a subcontractor advances some theory by substituting himself for the cost reimbursable prime, a contractual difficulty may result. If a subcontractor has lower tier sub-subcontracts, the situation may become more clouded. A solution may be to combine the specific flowdown requirements in a distinct general condition paragraph, with references to the applicable clauses. Standard subcontract documents should also be reviewed and revised as necessary to clarify the two different delivery methods that are combined in one Project.

Another area of confusion is in the difference between extra work and changed work. Extra Work is defined as something outside of the scope of work but desired by the Owner. Changes do not necessarily fall within this definition. One area where this is significant is that, as noted above, increases in subcontract amounts are only reimbursable if the cost is due to a differing site condition, Extra Work directed by the Owner, or variations in unit price items. The cost of changed work is not specifically

reimbursable. Fortunately, reasonable parties did not allow this to become an issue. There are other areas in the contract where this distinction could be problematic.

Bonding of the project is another area that could be reviewed. In a cost reimbursable contract, the risk to the Owner is changed significantly. The real risk is the cost of the fee, and the work included therein since, in the case of default, the contract terms would remain the same for the bonding company or the successor contractor.

### **BES Recommendations**

The roles of both Contractor and Owner regarding the administration of subcontracts should be studied to better define the expectations of both parties, specifically, the Owner's involvement in subcontract decisions regarding extra work, reassignment of work between subcontracts, and the settlement of subcontractor claims. Additionally, the contract attempts to differentiate how change clauses of the contract apply to the prime contractor and subcontractors. However, in practice, the management of this portion of the contract has been confusing.

The article stating that the costs due to the fault or negligence of the Contractor and subcontractors including the costs for the correction of damaged, defective or non-conforming work are non-reimbursable under the terms of the contract is standard design bid build (DBB) boilerplate language and is difficult to administer fairly in a CRFF environment. In a DBB contract, the contractor is afforded the opportunity to include risk or contingency in his bid and Owners often prefer to stay away from any involvement in Contractor means and methods. However, the CRFF language generally prohibits the contractor from including such risks in the fixed fee and in practice the Owner actually shares responsibility for the means and methods of construction. Interpreted literally, the contractor could be liable for any inefficiency experienced in his normal operations, which the Owner could then refuse to reimburse. A practical and reasonable application of this clause, including agreement on its application between Owner management and field staff, is therefore essential.

### **Suggestions for Contractors in Considering this CRFF Approach**

It is important to realize that this Cost Reimbursable—Fixed Fee type of arrangement is not without risk. While it is often referred to as a cost-plus contract, it is clearly not.

The Fixed Fee can only be increased in limited circumstances—Extra Work (work not provided for in the Contract Documents) by the Contractor or subcontractor, differing site conditions encountered by a subcontractor, Type II differing site conditions encountered by the Contractor, excusable delay due to fault or negligence of Owner—and only if an extension to Contract Time results from these circumstances. Type I differing site conditions or other excusable delays do not trigger an increase in fee, nor do changes in the work, although the Owner does pay the reimbursable costs. Contractors should not expect to be able to increase profits through increases in the fee.

The primary risk of the contractor is in control of the work schedule. If the work is completed early, the contractor still receives his full fee. The profit that is included in the Fixed Fee is therefore relatively secure.

If the work is completed late, the same fee applies, although overhead costs have been extended. Of course, the Owner is committed to completing the work on time. To that end, the Owner pays the reimbursable costs during a period of acceleration, if approved, so the contractor has some leeway in his ability to recover schedule.

Things to consider in pursuing this type of contract would therefore include:

- Adequate contract time is provided for the scope of work
- Reputation of the Owner for fair play

- Willingness to trust the Owner
- Willingness to commit resources for a modest profit
- Willingness to enter into a mutually beneficial partnership to complete the work

To a large extent, success under the contract depends on the good faith of the parties. There are a number of areas in the contract where a contractor could take advantage of the Owner, or the Owner could take advantage of the contractor. But there are checks and balances, and an unreasonable approach by either party will surely lead to disaster.

### **Suggestions for Owners in Considering this CRFF Approach**

Based on our experience with this contract and as previously stated, the success is dependent on the relationship developed between the Owner and its agents and the Contractor. This type of contract is not suitable for everyone or every project. The Owner is taking the financial risk for the Contractor's means and methods, which may be considered unacceptable by many Owners, while the Contractor absorbs the risk of completing within the contract time. However, we have found through this contract that there has been an incentive on the part of both parties to resolve issues swiftly and little to no benefit to either party for position letters to be written at the outset of a project challenge, event, or difficulty. But if the Owner mindset is present that the Contractor will always operate purely on self-interest, it would be difficult for an Owner to put in sufficient contractual wording to protect itself from any and all situations.

In considering the use of a CRFF contract, an Owner has a number of issues to consider. The first is the legislative environment regarding exceptions to low bid public works contracts and the contractual limitations of the exceptions, if any.

The second issue for consideration is the local political will. In our case, most members of the Portland City Council had prior experience with alternate construction contracts in the bureaus assigned to them and were therefore familiar with the process, advantages, and pitfalls, although none had experience on a major underground project. The perception that this type of contract is a "blank check" without protection for the Owner's budget may be insurmountable in some political climates.

Another consideration is development of a selection process that makes very clear the criteria and scoring mechanism used for selection, use of a knowledgeable and impartial selection committee, and payment of a stipend to short-listed but ultimately unsuccessful firms to offset some of the costs of participation in the procurement process.

Ultimately, an Owner must be willing to move forward without the typical risk allocation protection clauses available in a traditional lump sum or unit price contract. Acceptance of risk for a contractor's means and methods may be the biggest hurdle to overcome. In summary, prospective Owners should ensure that:

- Adequate contract time and budget is available for the scope of work
- Impartial technical resources are available to select a contractor based upon qualifications
- There is a willingness to trust the selected Contractor with the Owner's money
- There is acceptance of the contracting method at all levels of the Owner's project staff.

## **SUMMARY**

As of the writing of this paper:

- The project was substantially completed and fully operational 2 months prior to the mandated deadline.
- The original contract time was extended by a total of 50 days. Contract cost, taking inflation into account over the 47-month contract time, was within 1% of the original contract amount.
- The original aspirational goal for minority, women, and emerging small business contracting of \$13 million was exceeded by \$6+ million.
- Only one subcontract remains open pending a financial settlement. There were no prime contractor claims during the life of the contract.
- A Dispute Review Board, although noted as an expectation in the Request for Proposals, was determined to be unnecessary and was never utilized.
- No litigation attorneys received any fees as a result of this contract

## **REFERENCES**

Gibbon, P., Colzani, C., McDonald, J. 2005. Portland Oregon's Alternative Contract Approach—A Work in Progress. 2005 RETC, June 2005, Seattle, WA.