Final Report for Special Experimental Project No. 14

Design-Build Contract for the Penobscot Narrows Bridge

MaineDOT

June 2009

FINAL REPORT FOR SPECIAL EXPERIMENTAL PROJECT NO. 14

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prepared for the

Maine Department of Transportation

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This report prepared with the assistance of Morris Communications – Kennebunkport, Maine

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1.0 Introduction

The Maine Department of Transportation submits this Final Report under the provisions of Special Experimental Project No. 14 (SEP 14) for the use of innovative contracting processes.

This final report includes a brief scope of this Owner-Facilitated Design-Build project and a history of the project from the decision to replace the failing Waldo-Hancock Bridge in May 2003 through the opening of the Penobscot Narrows Bridge and Observatory in December 2006.

2.0 Project Overview: Background

2.1 Emergency Need for Bridge Replacement

In mid-2003, the Maine Department of Transportation (MaineDOT) was in the early phases of rehabilitation work on the Waldo-Hancock Bridge on Route 1 in Maine's mid-coast. The Waldo-Hancock, a historic suspension bridge dating from 1931, was due for major repair, including replacement of the layer of protective sheathing that covered the main suspension cables. As this layer was unwrapped, several of the cables were revealed to be in a much more advanced state of deterioration than previous spot-checks had indicated. It was clear that rehabilitation was no longer a viable option and MaineDOT went into high gear to replace the bridge as soon as possible. For safety purposes, the bridge safe load carrying capacity was reduced from 100,000 lbs. to 24,000 lbs.

The Waldo-Hancock Bridge is located on Route 1, the major arterial road in mid-coast Maine. The bridge is the only available crossing over the Penobscot River on the coast; the nearest bridge is 20 miles upriver in Bangor. The 40-mile detour through Bangor would require an additional hour of time for residents and schoolchildren to travel a half-mile from Prospect to Bucksport, the service center for the area. In addition, the bridge is the economic gateway to Downeast Maine and the Canadian Maritimes and a major freight route. All this, combined with safety concerns, made the need to replace the bridge as soon as possible paramount.

Clearly this situation drew much attention statewide. A balance needed to be struck between alerting truckers that they should take a different route and supporting the local tourist economy by assuring them the Waldo-Hancock was still safe to cross. MaineDOT accomplished this via vigorous 24-hour enforcement and an active media campaign.

2.2 Emergency Procurement/Safety

Meanwhile, MaineDOT worked with Maine Governor John Baldacci to allow an emergency procurement process and fast-tracked the environmental documentation. With these in place, the department put out a design Request for Qualifications (RFQ) in a matter of days and started making plans on how to structure a process that would enable a new bridge to be available in the shortest time possible. At the time, the department's en gineers warned that unless the Waldo-Hancock could be strengthened, the bridge might have to be closed to protect public safety.

Concurrently, to safeguard the traveling public and allow through truck traffic back on the Waldo-Hancock sooner, 16 new strengthening cables were designed, fabricated and installed—a feat never before accomplished on a standing suspension bridge. Installed four months from the time the bridge was posted, the new cables supported fully half the bridge's weight. At this point, the load was increased to 80,000 lbs. Audio monitors that would track any further breakage were installed to allow MaineDOT to continue to gauge the old bridge's safety during construction of the new bridge.

2.3 Challenges

The challenges to this schedule were significant. First, the public would have to support building the new structure, and many were already angry that their historic bridge had deteriorated. Second, the state had no immediate funding available to cover costs. Third, because the new bridge would be replacing a historic state landmark, the Maine Historic Preservation Commission would also need to be satisfied with the outcome. Finally, it typically takes a decade to plan for and construct a structure of this scope. MaineDOT planned to do it in record time. These factors clearly called for a flexible process that would give the owners the ability to make quick, yet fully educated decisions, with no downtime between construction phases.

2.4 Goals

As guidance during this process, MaineDOT developed the following goals to provide a new bridge crossing:

- A high-quality project
- Open to traffic by June 30, 2005
- A reasonable cost for the value received
- A fair and competitive bidding process
- An early and productive relationship between the Designer and the Contractor

3.0 Project Overview: Innovation

With speed an imperative, MaineDOT applied for approval for a Special Experimental Project #14 (SEP 14) designation in order to put in place a unique contract delivery process to reach its goals. The Federal Highway Administration approves non-traditional contracting arrangements via SEP 14 approval. SEP 14 approval allowed MaineDOT to take a Best-Value approach selection for its contractor as long as specific federal criteria were applicable.

With the SEP 14 approval in hand, the department selected a contractor with only a conceptual design completed, based on a competitive Best Value basis, using qualifications and a price comparison based on unit costs and representative quantities.

3.1 Balance of Power/Control Issues

The key to success was developing a process where teamwork was not just a concept but a very high priority. Constant communications were necessary. During the design/construction process, the team was on the phone daily, with scheduled weekly working team meetings and bi-weekly management meetings. The team was aware that actions could not be taken without discussion and agreement amongst the group. And since time was a factor throughout, this meant ongoing discussion. Moreover, the owner played a unique role. The owner had to be totally committed to the process, and be willing to act as the balancing agent. When conflicts occurred—as they did—the goal was to resolve them in a positive manner and to move on.

The benefits of this unique process were very real. By working together so closely, the team was able to design a major, complex project that was constructible within an abbreviated time frame. Moreover, this was a project that included such innovations as a simplified cradle design that minimized construction complexity while safeguarding the cables, and the first public tower observatory in the Western Hemisphere. It proved that this kind of a process can improve the efficiency of delivery. It also proved that in a crisis situation, increased risk-taking can lead to major innovation.

Throughout the process, communications among the partners was critical. From the outset, MaineDOT required input into the selection of project personnel in order to make sure needed skill sets and personal attributes were in place. This process also gave MaineDOT unprecedented access to contractor cost data, as the team worked hands-on through multiple different methods of design, construction and daily problem solving.

The challenges were real as well. Procurement alone was challenging. MaineDOT needed a designer and contractor that could work well together. For this unique and accelerated process to be successful, many intangibles were required. A low bid process would not be possible given the uncertainty of the design parameters and scope of work. Further, it is very hard work for a team to be continuing to develop a better, quicker, cheaper way to construct a project at the same time that a previous phase is being built. It requires staff that can multi-task and focus at the same time. It requires a minimum of ego at the table, as the best idea may be someone else's. And it requires a maximum of flexibility because the one constant was change. This was particularly challenging for a project that was squarely in the public eye.

3.2 Project Administration

The many changes and adjustments that were made to plans and drawings during this process required an unusual degree of communication. MaineDOT typically requires a series of partnering meetings for major projects and this one was no exception, with four sessions taking place once construction got under way. But the real communications work took place much more often than that as evidenced by the project meeting schedule below:

- Daily job site meeting: 6:30 am
- Weekly project meeting: Tuesday 8:00 am
- Weekly progress meeting: owner, designer, LLC by phone Wed. 10:00 am
- Twice monthly policy meeting: 2nd & 4th Friday 9:00 am
- Monthly senior executive status meeting at project site: Tuesday 1:00 pm
- Monthly LLC Principals and MaineDOT: Tuesday 8:00 am
- Weekly safety meeting: Tuesday 6:30 am

Further, the attached Design-Build agreement for the project, which includes organizational charts, clearly shows the interrelationship and working arrangements among the partners.

3.3 GARVEE and Other Funding

Funding was another major challenge for this project. Typically, major bridge replacements are planned years ahead of time, allowing time to prioritize and allocate funds. However, to make construction of the Penobscot River Crossing possible, for the first time MaineDOT took advantage of GARVEE (Grant Anticipation Revenue Vehicle) funding, which allows a state to receive future FHWA funding in advance. The GARVEE funding totaled approximately $50 million of the $85 million total cost. Of the remainder, $17 million came from Maine State Highway Bond Funding or other Highway Funds, and the rest from SAFTEA-LU, Congressional Allocations and Federal Enhancement Funds. This funding required a combination of reallocating funds from existing Maine projects and convincing legislators and voters that the project warranted a bond issue.

3.4 Observatory Construction and Operations

3.4.1 Observatory Challenges

Construction of the Observatory was concurrent with bridge deck construction, with the exception of the final four months; the bridge was opened to traffic on December 30, 2006 and the Observatory opened to the public the following May 19th. Constructing and making the Observatory operational had its own set of issues, particularly in terms of design, elevator installation, permitting and selection of low-maintenance materials. To make sure both projects met the timeframe, the Observatory was treated as a separate though intersecting project. The team communications and flexibility in approach that was required to design and construct the bridge was put to good use by the Observatory team as well.

The first challenge was designing an Observatory with its lifting mechanism housed below the top floor. The idea behind the Observatory was to provide visitors with a 360-degree vista. Standard elevator construction includes a lifting mechanism on the top floor. Bringing the elevator to the floor below and providing stairs to the top – the obvious answer – would not allow access for people with ambulatory handicaps.

In response, the Team design included an innovative lifting mechanism located below the pylon, and a specially permitted one-story lift for people who can't climb stairs.

3.4.2 Community Theme

It is in the Observatory that the community's desire for a granite-inspired theme is best illustrated. A top floor tiled in local Deer Isle granite, and a base floor and terrace paved with local Mosquito Mountain granite are set off by massive granite wall sheathings and entry facings. An additional nod to history is in the entryway and iron gate, both replicas of those seen at neighboring Fort Knox.

3.4.3 State Agency Partnership

Finally, constructing the Observatory was only the first step. To make the new tower open to the public, MaineDOT worked very closely with Maine's Department of Conservation, which owns and operates the adjacent historic Fort Knox as part of the state park system. Details of final construction, hours of operation, funding, staffing, cleaning, maintenance and even public communications all had to be established in a way that was agreeable to both parties.

3.5 Inert Gas System

In 2004, the concept of pumping nitrogen gas into the stay pipes was introduced in order to provide two additional forms of corrosion protection for the cable stays. First, it would provide an oxygen-free environment; second, a monitoring system would be able to detect loss of gas pressure in the stays. As understood by all parties (FHWA, MaineDOT and the LLC), this was a brand new experimental process and was priced as such. At the final pricing meeting in November 2004, it was noted in the minutes that there was no guarantee of success.

The construction sequence did not allow engineers the opportunity to pressure-test the stay pipes until the main span was closed and final geometry established. At this point it was discovered that over 50% of the stays pipes did not hold pressure. Ultimately, after injecting epoxy to close all deck-level leaks, the site of the problem was determined to be the flanged connection of the HDPE sheath to the pylon cradles.

This raised significant questions about the long-term performance of the system, as none of the proposed repairs guaranteed that the flange leaks would be 100% eliminated. Deck-level repairs were also deemed potentially inadequate for the long term. In addition, maintenance and safety issues arose in regards to the system's barriers to easy access to the bridge box, the need to frequently recharge the nitrogen bottles, and the possibility of potential nitrogen leaks within the bridge box.

As a result, the decision was made in November 2007 to substitute a dry air cable stay system. This system, proven around the world in suspension bridges, reduces corrosive humidity and was successfully adapted to provide a monitoring system that would identify any breach in the HDPE sheathing. The Penobscot Narrows Bridge is ideal for such a system based on the dry conditions inside the bridge and the tightly sealed nature of the stay pipes. While not the original plan, this adaptation has resulted in an innovative state-of-the-art cable protection system.

3.6 Carbon Fiber Strands

Towards the end of the construction period, the Penobscot Narrows Bridge, with its humid marine environment, was identified as an ideal site to test the load performance of carbon fiber strands versus steel strands. Federal funds were provided for this test, which is being managed by the University of Maine. A total of six steel strands have been replaced with carbon fiber. Three different cable stays, comprised of 45 strands each, each had two steel strands removed and replaced by the carbon fiber substitutes. The load performance of these new strands is measured periodically on site by connecting a laptop to the magnetic Dyna-Force monitoring technology.

4.0 Designer Selection Process

From a design perspective, this project had some very specific challenges. MaineDOT required a design firm that had specific experience with projects incorporating:

- A minimum 800-foot navigational span
- Deep water foundations
- Innovative contracting and construction methods

Based on these needs, immediately after discovering that the Waldo-Hancock Bridge could not be rehabilitated, on July 2, 2003 the department solicited a Statement of Qualifications (SOQ) from highly qualified firms to provide professional design and construction services for the new bridge. Fourteen initial responses were received, and of those, three were able to fulfill the above criteria. Of the three, Figg Engineering Group, a firm that had recently completed Maine's design-build Sagadahoc Bridge project, was chosen on July 16.

5.0 Public Process

5.1 Background

In July, shortly after Figg was contracted with and concurrent to the contractor procurement process, MaineDOT and Figg Bridge Engineers began a public process to solicit feedback on a new bridge design. Meetings with the communities began in July, first to update residents on the plans and timeline to replace the Waldo-Hancock Bridge. In August, meetings began in earnest to start to determine a balance between the best aesthetic for the region against the realities of construction and maintenance costs and the need for an accelerated delivery time. Residents began the process with a sense of entitlement, as in their view the demise of their beloved historic bridge had been tied to inadequate maintenance by MaineDOT. They stated that they wanted a new bridge that as closely as possible resembled the old one: a steel suspension bridge. The department knew that the maintenance such a bridge would entail was not a good choice given the state maintenance budget, and believed that a more modern, cable-stayed structure would be the best choice. But the community was adamant that such a design would be an anomaly in their architecturally traditional region.

5.2 Concrete vs. Steel; Cable Stay vs. Suspension

Meetings continued into October, covering the technical details and differences between steel suspension and concrete cable stay bridges. In October, a set of six different bridge designs were proposed, ranging from a single plane cable-stay to a double-plane version that resembled the old bridge. Since the new bridge would be twice as wide as the old bridge, the double-plane version was of a significantly larger scope than the petite Waldo Hancock. The public still leaned in that direction, but the close, second choice was a cleanly designed single plane version. And when asked to choose a theme for the bridge, the public rejected all suggestions in favor of a “granite” theme that would honor the significance this stone has had on the local economy. This suggestion opened the way for an innovative idea.

5.3 The Observatory

While researching traditional shapes that could be incorporated into the design, MaineDOT discovered that the Washington Monument was built partially of granite from nearby Mt. Waldo. This led to the solution of modeling the towers after the Washington Monument – and incorporating an Observatory at the top.

Figg and MaineDOT spent two weeks determining whether this idea was feasible from a design, construction and operational standpoint. Once the answer was positively determined, MaineDOT and Figg went back to the community and presented the new visual concept – complete with Observatory. The response, just five months after the community had been told the Waldo-Hancock would be replaced - and just as a contract with a contractor was signed - was a unanimous yes.

6.0 Contractor Selection Process

6.1 Request for Qualifications

On August 14, 2003, a Request for Qualifications (RFQ) was made available to selected contractors, asking for information on their qualifications to construct a large cable support bridge at the given location. As indicated before, this was a challenging project for the region. Enough information was provided in response to allow the department to short-list three firms and provide them with a more detailed Request for Proposal (RFP) within a matter of weeks. The goal was twofold: to secure a firm bid proposal to build two bridge foundations in one contract and to secure reference bid prices for the complete construction of the proposed cable stayed bridge and its approaches.

6.2. Request for Proposals/Bids

The RFP responses would include information on:

- Experience and organizational structure as it related to the specific project
- Planned schedule and ability to support it
- Comparison of price proposals for four contract prices:
    - Pylon Foundation Bid Price
    - Bridge Approach Reference Price
    - Concrete Bridge Reference Price
    - Steel Bridge Reference Price

NOTE: Reference prices were broken down to show unit prices, corresponding labor costs, equipment costs, cost of materials, direct jobsite overhead and the ratio of fixed to variable costs and proposed profit for the items.

Five areas were used to evaluate the contractors' proposals:

- Experience and capability
- Quality
- Schedule
- Confidential Interview
- Price

The contractor with the best value proposal would be selected to build the two foundations and would at the same time collaborate with MaineDOT and Figg to design and ultimately construct the cable stayed bridge project – as long as a reasonable contract agreement could be negotiated.

Two of the three short-listed contractors provided proposals, based on the 30% project plans and specifications provided. On November 12, 2003, the proposals were opened and the Limited Liability Company (LLC) comprised of Cianbro/Reed and Reed was the best value proposal. The proposals from both bidders, however, were more than 50% higher than the MaineDOT engineer's estimate, a gap that would have to be negotiated quickly.

7.0 Pylon Foundation/Reference Price Process

The first item to resolve was the Pylon Foundation contract, as the schedule called for ground to be broken before year-end. The LLC's bid came in at $10.5 million; the engineer's estimate at $5.9 million. Part of the difficulty came from the fact that although the bridge had been determined to be a single plane cable stay design, many other factors were still undetermined. As a result, MaineDOT, the LLC, and Figg had to agree on the construction details for a foundation to support an unknown structure. This was the first test of the partners' relationship; and based on agreements of cost saving changes in construction methods and materials, and foundation size and type, a final agreed price of $8,280,445 was reached in early December, with the project awarded on December 12, 2003.

8.0 Bridge Structure/Initial Contract

The reference price contract approach, as shown in Section 6, allowed the foundation contract to be executed, and the LLC immediately mobilized to begin work. In a parallel path, the design team, which consisted of the LLC, Figg, and MaineDOT, began collaboration through joint iterative meetings to develop and refine the bridge structure and approach design, using the proposal's contract reference quantities and prices as a starting point. The goal was to have the new bridge open to traffic on June 30, 2005. Team meetings had begun on November 13, 2003, with the goal of coming to an agreement on the foundations methods and price; meetings continued regularly over the next 12 months as the team worked to define and refine structure types, configurations, construction techniques, schedule and cost.

From December 2003 through March 2004, the team investigated cable stayed bridge types and configurations including, but not limited to, steel beams with concrete deck, pre-cast concrete beam with concrete deck, concrete box and deck with steel pylons and single plane trapezoidal steel box. These were weighed against cost, maintainability, bridge life and constructability.

8.1 Bridge Structures under Evaluation

At a March workshop, the following options had been investigated and costed out. All included a $3.1 million allowance for an Observatory.

- Single Plane Cable Stay, Precast Box: $66.5 million
- Single Plane Cable Stay, Precast Beam, Precast Box: $54 million
- Single Plane Cable Stay, Precast Beam, Cast-in-Place Box: $53 million
- Single Plane Cable Stay Steel Hybrid: $55 million
- Single Plane Cable Stay, Cast-in-Place Box: $58.5 million

During the workshop, iterative plan sets were generated, allowing refinement of design, construction issues and reference price. At this point, Observatory issues and costs were being investigated only on an order-of-magnitude basis.

Steel bridge maintenance issues and concrete structure concerns about how the connections would be made between cable stays, precast beams, through the box and into the backspan led to the decision to build the cable-stayed CIP Box structure. With this resolved, the team continued to meet to further optimize design, construction and value.

During this time, the Waldo-Hancock strengthening project was completed, giving the engineers confidence that the structure would be able to handle trucks and tourist traffic for a longer period of time. This allowed the team to lengthen the schedule, making the more cost-effective cast-in-place option possible. This created a $3 million savings as it negated the need for precast plants on both sides of the river.

9.0 Lower Pylon, Ledge Cut Contracts

A contracting approach that worked well to keep the process moving was the decision to break out certain agreed on items and quantities, such as the Lower Pylon. To ensure that unresolved aspects of the contract negotiations would not affect the project schedule, this aspect of the project was developed as a separate contract. The original engineer's estimate was originally agreed to at $4 million. The final plans included additional reinforcing steel quantities, which brought the contract total to $4.423 million. The contract was signed on May 7, 2004.

Earlier, prior to the proposal opening, Figg and MaineDOT had also begun developing a separate Ledge Cut project that was not part of the original Request for Proposals (RFP). This separate contract was to be a traditional design-bid-build project, and was necessary to complete the southern approach to the bridge. During this same period as the Lower Pylon contract was being developed, the Ledge Cut contract was being refined, with LLC input. Since the process of contract negotiation for the Lower Pylon contract has been successful, MaineDOT and the LLC initially agreed to negotiate the ledge cut engineer's estimate of $3.98 million, but could not agree on a final price. The final negotiations between MaineDOT and the LLC set a final price of $3.98 with a contingency that if they were not awarded the bridge completion contract, they would get an additional $250,000 for project management. After consideration of this, MaineDOT decided to go out to bid as originally intended for the Ledge Contract. The result of this was that Lou Silver, Inc., of Veazie, Maine, was the low bidder at $3.298 million. The LLC's bid based on the advertisement was $3.854 million. On August 11, 2004, the contract was awarded to Lou Silver.

10.0 Bridge Structure/Observatory Estimates

The final bridge structure contract was negotiated during the period between late spring and November 2004. At the start of that period, the major price discrepancies between the engineer's estimate and the LLC's were in five high-value categories: cable stays and cradle system, inert gas protections systems, structural reinforcing steel, bridge lighting and concrete quantities. At this time, MaineDOT had also made the decision to extend the bridge opening to November 15, 2006. The monitoring data and telemetry reports during the first critical winter indicated that the Waldo-Hancock Bridge's cables were stable and that the strengthening cables were doing their job. Assured that traveler safety was not at stake, MaineDOT's intent was to provide more negotiating room in an effort to come to agreement.

10.1 Independent Estimate

At the start of this time period, MaineDOT believed it would be prudent to get an independent estimate and brought in Trauner Consulting Services, Philadelphia, PA to review plans and specifications. Trauner and the design team met on June 18 to discuss the design and its constraints, and to reach agreements to determine a final price, based on the most recent drawings as well as an updated package to be received July 12.

Trauner's first iteration yielded a bridge estimate of $43.8 million (without approaches, foundations or Observatory). After discussion with the team, the estimate was revised to $44.7 million. At this point, the finalized pay items, quantities and scope of work were defined, but the price gap remained. The focus became how to resolve the differences in direct cost, indirect costs, overhead and profit. The team and Trauner met again in September to finalize direct and indirect costs. The team also finalized the not-to-exceed items. In order to facilitate the negotiations, the opening of the Observatory was moved back to May 2007. Continuing research and design on this unique structure, estimated in April 2004 at $3 million, made the price difficult to determine.

10.2 Innovative Contract Items

The team continued to refine and revise the plan and specifications, leading to additional comparisons of fixed and indirect costs. In October, the final direct cost (minus equipment) difference after discussions between Trauner and the LLC was $36.1 and $41 million for MaineDOT and the LLC respectively. Further discussions between management of the two organizations continued with final specific contract provisions including:

- Identifying allowance items that needed further details or engineering to accurately determine cost. These eleven items (Highway Approach, Viscous Dampener System, Inert Gas System, Patio Deck, Storm Louver, Glazed Aluminum Curtain Wall, Poly carbonate Fabrications, Vertical Platform Lift, Fire Pump, Aesthetic Lighting,
- Observatory, Maintenance, Warning Lighting) were valued at a high of $4.7 million, a not-to-exceed amount that would be less once scopes were finalized.
- A labor-cost risk-sharing agreement was part of the superstructure contract, in which labor was estimated at $3 million. MaineDOT believed this was conservative. It was agreed that any savings in this area would be split between the LLC and MaineDOT at the close of the project. At the end of the project, the LLC estimate was proven accurate; however, this contract option had allowed both parties to move ahead to the satisfaction of both.
- An independent audit will be generated to determine that the LLC's rates were not overstated. If the audit finds them overstated, the LLC will pay an adjustment to MaineDOT. At the end of the contract, the audit took place and determined that the rates were not overstated.
- Profits from salvage or equipment sale (specifically the travelers) that takes place after construction will be split between the LLC and MaineDOT.
  A Contract Management Fund of $750,000 was set aside to cover legitimate increases in actual cost to the contractor. This fund was not intended for increases due to scope change, but was developed to encourage contract disagreements to be handled at the lowest possible level. If all work was completed in accordance with the contract and any and all disputes were settled, the contractor would be able to receive a lump sum payment of the remaining funds. At the end of the project, the fund had been used for price escalations in the membrane, finger joints, precast infill, and DSI (vendor) costs. The lump sum payout was $357,728.69. MaineDOT and the contractor agreed that this was generally a successful contracting tool. Although both

also agreed that in the future, a much clearer understanding on the appropriate use of the fund and how it was included in the ultimate cost of the project was needed.

10.3 Final Estimate

MaineDOT's final estimate was $56.6 million (including the Observatory and approaches but not the lower pylon). This led to a final negotiated lump sum price of $56 million. This was agreed to on November 12, 2004 and became the basis for constructing the remainder of the bridge: superstructure, upper pylons, Observatory and approaches.

11.0 Changes in Public Attitudes

11.1 Bridgewalk

On October 12, 2006, just three weeks after the bridge deck had been connected, MaineDOT opened up the new bridge for a pedestrian walk for a 6 hour-period. Since 2003 when the news had swept the region that the Waldo-Hancock would be replaced, the construction of this bridge had been a major source of attention, with weekly mentions in local media. Support had been strong, and MaineDOT and the partners wanted to give the public a closer look at what would be a source of regional pride for decades to come.

Organized by a local group of volunteers, the event exceeded wildest expectations, with tens of thousands of people thronging the bridge deck for the full 6 hours. Marching bands, bag pipes, music, barbecue, children, dogs, people in wheelchairs – the event had it all, with rep resentatives from MaineDOT, Figg and the LLC stationed along the deck to answer the many questions. When the day was over, clean-up crews found that the public's respect for the bridge and what it represented had translated to an aversion to littering: there was virtually no trash to clean up. It was a fitting footnote to what had started as one of the most controversial projects the state had ever attempted.

11.2 Bridge Opens to Traffic

On December 30, 2006, the bridge was opened to traffic and at the same time, the Waldo-Hancock was closed. This was intended as a relatively low-key opening, but the public insisted on a parade consisting of old cars and fire trucks from around the region. It was snowing, so the first official vehicle to cross the bridge before the parade was a snowplow. But none of this dampened the spirits of those who came to see history made, and the opening went smoothly.

12.0 Overall Lessons Learned

12.1 Owner-Facilitated Design-Build Process

This project could not have been completed within 42 months under any other contracting mechanism than this one. While design-build contracting is now relatively common, this project went a step further by fully including the owner in each step. We call this “owner-facilitated design-build,” allowing for faster decision-making and more creativity in finding the right answers. It was imperative that the public, represented by the owner (MaineDOT), be involved with all the major decisions impacting the final product. The traditional design-build process was not fast enough because major conceptual decisions were made while foundations were being built. The team orientation was another critical component, and it is not an overstatement to say that without the full collaboration of all three partners, this project would not have had a successful outcome.

As an illustration of how important the communications element is, below is a verbatim account from the minutes of the July 2005 Partnering Session.

MaineDOT

- Spent half the money
- Project going well
- Pleased with Production
- Some problems, but no show stoppers
- However, right about now is when Partnering becomes critical – a lot of operation happening
- Just coming out of the learning curve
- How we react to issues now will determine our success
- Got a few things to work out

Figg

- Things are going well
- Lots of things happening at once
- Lot of smaller partnering meetings
- Very impressed with how well the Team is working together

LLC

- This is a key point in the construction season
- It is easy to slip into old roles at this juncture in a big project
- But giving a little extra gets the same response from other Team Members
- Here to narrow our focus today and be productive

By definition, this method is very time consuming and requires a knowledgeable, fully engaged owner. As such, it is not suitable for all projects. But it is highly recommended for any project that is complex and time-sensitive.

One of the most important things is for the Team to identify those items that are on the Critical Path and keep them moving. This allows the Team to focus on accomplishing what is really necessary to keep on schedule and gives them the incentive they need to make sure decision-making occurs. The special contracting items in Section 10 are also highly recommended. Some of these items were developed to keep the project moving even when certain items could not be finalized. Others were developed to provide a fair compromise in those areas where there was still a gap in projected costs. They all played an important role in keeping to the schedule and minimizing costs.

12.2 Inert Gas System

Lessons learned during the attempted installation of this experimental system are twofold: the need to more carefully install the narrow O-ring connection between the HDBP flange and the cradle, and the need to develop a better system nitrogen delivery system inside the bridge.

12.2.1 Installation Issues

During the period when the sheathing was being tested for leaks, engineers determined that there was a disparity among stays in the way the flanges were connected to the cradle system. It was determined that an improved QC process could be developed to help solve this problem.

12.2.2 Nitrogen Delivery

Two potential long-term maintenance issues were identified. First, frequent recharging of the nitrogen bottles would be time-consuming for bridge maintenance personnel, and this problem would be exacerbated over time. Second, OSHA considers the presence of nitrogen a risk, making safety procedures inside the bridge more complex. This means that regular access to the bridge to monitor and inspect equipment also becomes more time-consuming. Regardless of the benefits of an inert gas system, these day-to-day maintenance costs are problematical in today’s economic environment, and a less maintenance-intense, safer nitrogen delivery system would be a better solution for future structures.

13.0 Final Bridge Specifications and Final Schedule

13.1 Final Specifications

- Type: Single Plane Cable Stayed
- Length: 2,120 feet including approaches
- Length of span: 1,161 feet
- Deck width: 40 feet
- Height of Pylons: 420 feet
- Underclearance: 142 feet
- Total height: 447 feet
- Materials used: Concrete, steel rebar, epoxy coated steel cable stays
- First Bridge Observation Tower in the Western Hemisphere
- Tallest Bridge Observation Tower in the World

13.2 Final Schedule

- December 3, 2003: Groundbreaking
- April 2004: West foundation complete
- June 2004: East foundation complete
- November 2004: Both lower pylons completed to deck
- December 2005: East upper pylon complete
- April 2006: West upper pylon complete
- July 2006: East backspan meets land
- August 2006: West backspan meets land
- September 2006: Observatory ring beam placement
- September 2006: Bridge deck meets in middle
- September 2006: West tower roof placed
- October 2006: East tower roof placed
- December 2006: Bridge opened to traffic
- May 2007: Observatory open to the public