JURISDICTIONAL APPROVAL OF KEYHOLE PAVEMENT RESTORATION

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ABSTRACT

Washington Gas (WGL) partnered with the Gas Technology Institute (GTI) and major keyhole vendors to promote and utilize keyhole technology techniques for use in the greater Washington, D.C. area across several paving jurisdictions. The primary focus of the project was to advance the current state-of-the-art small-hole technology within Washington Gas with a focus on gaining jurisdictional approval through presentations and field demonstrations. Keyhole technologies have been successfully employed by utilities for many years to reduce excavation and restoration costs. However, gaining jurisdictional acceptance of paving core reinsertion is relatively new.

The project focus incorporated the complete process integration of street coring, vacuum excavation, O&M work through small holes, and pavement core restoration. The project utilized existing keyhole methods, tools, procedures, and products to achieve a successful program startup. To insure success, WGL used experienced contractors and service providers known in the keyhole industry. This paper outlines the steps Washington Gas took to both start up its keyhole program and the steps necessary to secure jurisdictional approvals for pavement core reinsertion.

Introduction

Headquartered in Washington, D.C., Washington Gas Light Company (WGL) is a natural gas distribution utility that serves over one million customers throughout the District of Columbia and the surrounding regions in Maryland and Virginia. WGL's system has a large growth rate of approximately 3% by adding upwards of 30,000 new customers per year. WGL has targeted new operations and construction technologies in order to help minimize skyrocketing construction and pavement restoration costs. New technologies adopted include keyhole construction and pavement restoration techniques.

Washington Gas worked with the Gas Technology Institute (GTI), the Keyhole Research Collaboration Committee, and major keyhole product vendors to promote and utilize keyhole technology. The primary focus of the project was to advance the current state-of-the-art small-hole technology within Washington Gas with a focus on gaining jurisdictional approval for cored pavement reinsertion. Keyhole technologies have been successfully employed by utilities for many years to reduce excavation and restoration costs. However, gaining jurisdictional acceptance of paving core reinsertion is relatively new.

The project incorporated the complete process integration of street coring, vacuum excavation, O&M work through small holes, and pavement core restoration. The project utilized existing keyhole methods, tools, procedures, and products to achieve a successful program startup. To insure success, WG used experienced contractors and service providers known in the keyhole industry. This paper outlines the steps Washington Gas took to both start up its keyhole program and the steps necessary to secure jurisdictional approval for pavement core reinsertion.

The Keyhole Construction and Pavement Restoration Process

As with arthroscopic surgery, innovative methods have been introduced for utility construction and maintenance from the road surface without extensive excavations. Rather, the work is conducted through much smaller "keyhole" cuts. The process is much less intrusive and has many benefits for the company, permitting authority, and traveling public.

Rotary diamond saw coring provides small cuts in asphalt and concrete sub-base (including steel rebar) in diameters of 12" and 18". A vacuum truck is used for soft dig excavation, thereby eliminating the need for other pieces of equipment such as backhoes and dump trucks. High-pressure air tools are used to cut the soil over the utility, allowing the vacuum truck to remove the soil with a negative airflow or "vacuum." New construction, maintenance or repairs to utility lines are conducted through the small hole with long handled tools, much like building a ship in a bottle.

Once the utility work is completed, approved backfill materials are compacted back into the excavation. Rather than re-pave the excavated area and further disturbing the public, the original pavement core is grouted back in place. The aim is to restore the pavement quickly to a smooth structurally sound and aesthetically pleasing state. No additional paving or mill-and-overlay is needed.

Project Objectives

Washington Gas targeted two major project objectives. WGL would first need to start a keyhole program by procuring, developing, training, and promoting keyhole technology within its franchise where none existed before. The primary incentive was cost driven. Keyhole construction and operation

techniques are estimated to cost approximately one third to one half of conventional excavation methods. An experienced keyhole crew can typically outperform a conventional crew about three jobs to one. Savings from crew productivity alone would make the project worthwhile and would easily justify capital expenditures for the specialized equipment and tools.

Once the program was viable and the crews fully trained and efficient, the second major focus was to promote and secure jurisdictional approval from the larger paving jurisdictions in the District of Columbia, Virginia and Maryland territories. Paving restoration costs in the WGL franchise area skyrocketed by a factor of five (5) in the last five years from 1999 to 2004 with current restoration costs above $10 million dollars per year. Jurisdictions are requiring extensive same day pavement restorations, followed by extensive pavement mill-and-overlay. Keyhole technology is one construction and operations methodology in WGL's toolbox for helping to lower restoration costs.

Part 1: Building a Successful Keyhole Program

Keyhole Program Startup

Washington Gas' keyhole program started in late 2003. It came as a result of research and the commitment of senior management to lower O&M and pavement restoration costs. WG joined GTI's Keyhole Research Collaboration Committee whose focus was the education, development and promotion of keyhole processes. In polling the Committee, "What are your concerns involved with implementing keyhole technology?" the majority of the members responded that gaining jurisdictional approval was at the top of the list. With other major distribution companies and GTI offering support, WGL embarked on starting a keyhole program that would focus on gaining paving jurisdictional acceptance and approval.

Teaming with Experienced Partners

Washington Gas chose to insure successful development of its keyhole program by using all available resources including the Gas Technologies Institute, experienced vendors, consultants, and contractors. WGL tapped into these knowledgeable sources for knowledge, training, experience, and industry connections.

The GTI Keyhole Research Collaboration Committee was utilized for research and a sounding board for startup ideas. The committee was comprised of 17 other companies, many of whom had already started their own program and were at varying stages of development. The committee members provided excellent benchmarking, ideas and support.

In addition, leading vendors in the keyhole industry were employed as team members to assist in making WGL's startup and jurisdictional approval project a success. WGL was not just looking for vendors: we were looking for teammates that had a stake in the project's success. Consultants were selected that specialized in soil mechanics and pavement restoration, and others in pipeline construction and keyhole techniques. In addition to WGL's own crews, contractors were selected that had vacuum excavation equipment and advanced keyhole knowledge. WGL selected the following vendors, consultants and contractors to help secure success:

- Utilicore Technologies — Coring Equipment and Utilibond® Grout
- Servac / Omega Tools, Inc. — Training, Tooling, Vacuum Technology
- Glyn Hazeldon — Consulting – Keyhole and Jurisdictions
- Alan Todres — Consulting – Pavement Restoration
- Miller Pipeline — Contract Keyhole Crews
- Northern Pipeline — Contract Keyhole Crews

Selection of Equipment, Tooling and Materials

In selecting the keyhole equipment, tooling and materials, the focus was on reliability and success. WGL could not let any early failures occur in the program. It is said, "You only have one opportunity to make a good first impression." Equipment was chosen for its durability and ability to work on the thick hard streets in the District of Columbia. Good early impressions were necessary during all demonstrations to the permitting jurisdictions. A failed demonstration due to poor equipment would have been detrimental to achieving the needed approvals. Smaller coring equipment failed in early evaluation and testing. The Utilicore core cutting truck was selected due to its robustness and the ease at which it cut through 24" thick concrete, steel rebar and asphalt pavement. The coring rig cut through the toughest pavement in as little as five minutes.

Utilibond® grout was selected as the core bonding agent due to its long history of success by Enbridge Gas in the streets of Toronto, Canada. Enbridge had successfully been restoring pavement core plugs from the early 90's. Over 5,000 cores have been reinstated over the years that have weathered the harsh climate conditions and frost heave without failure. In addition, Utilibond® grout has been tested by third party engineering firms and universities, providing a plethora of engineering documentation to share with the permitting jurisdictions.

Benchmarking with the Keyhole Research Collaboration Committee members, research and evaluation pointed WGL towards selection of Omega Tools, Inc. as the provider of tools, vacuum technology, and keyhole experience. Their specialized tools are well designed, rugged and functional. Omega's technicians trained WGL crews on both the equipment and processes for successful keyhole operations. During the project startup, an Omega technician was always on site providing technical and hands-on support.

Alliance Contractors

In addition to three Washington Gas keyhole O&M crews, third party contract crews were utilized to help start the program. Miller Pipeline, Northern Pipeline, and Lineal Industries provided vacuum excavation crews to do various jobs on WGL's system. Communication and promotion of keyhole methods to the contractors was incorporated as part of the keyhole focus. Their crews were used as resources in various areas of the WGL system. Although the contractors had various levels of expertise in vacuum excavation, none had utilized the pavement core cutting and resetting process. Where

possible, WGL's coring truck was scheduled to cut the pavement ahead of the contract crews. Keyhole project outsourcing to WGL's alliance contractors is currently being fostered and developed.

Project Staffing

WGL's internal project management, crew leadership and staffing were selected based on skill levels, but also for enthusiasm and ability to embrace the new process and technology. A team was needed that would help promote the process in the event that jurisdictional personnel or inspection staff appeared on the jobsite. Internal WGL promotion to other staff was an added benefit. Crew technicians were selected for the "right attitude" and ability to think creatively. Lead technicians needed to be able to enthusiastically demonstrate and answer questions during field demonstrations. The special nature of the project helped promote strong teamwork. Initially, three vacuum crews and one coring crew were staffed each with a senior technician and helper. A field foreman led the day-to-day planning, scheduling and crew assignments.

Training

Since WGL had not previously utilized keyhole coring and vacuum excavation processes, it was necessary to provide good training and support for the new crews. A seasoned and experienced technician was contracted from Omega Tools, Inc. to train the crews and to assist the field foreman. The technician also aided by promoting the processes during early field demonstrations.

Hands-on training and practice was accomplished at WGL's operating center prior to any street excavation. Pavement coring and restoration was practiced extensively in a side parking area mocked up with concrete and asphalt. Experimentation and variation of techniques was encouraged. In many cases, the crews recommended modification of equipment, where necessary, for ease-of-use, productivity, and ergonomics.

Startup Focus and Strategy

Numerous keyhole processes are currently available to the industry, many of which are new or under development. During the early stages of startup and for the jurisdictional demonstrations, WGL relied on more common "tried and true" keyhole processes. The selected processes included (1) cathodic protection activities including anode and CP test station installation, (2) anaerobic cast iron joint sealing, (3) low pressure service cut-offs, and (4) depth and location surveys. Training and tool selection was focused in these four areas. Experimentation in other processes came later with advanced experience and company need.

In early project planning, the project team believed that securing advance permission from the jurisdictions was needed prior to any excavation. However, this logic proved faulty and time-consuming through jurisdictional bureaucracies. The crews would be idle and non-productive while waiting on advance permissions from the engineering department at the jurisdiction. A different strategy of starting with a "just do it" approach was adopted. Street core cuts were requested on an individual basis through normal permitting channels. In all cases, permits were approved. Jurisdictional quality inspectors seldom had issue with the keyhole work process or restoration. If requested, WGL would have restored any cored cut to the jurisdiction's specifications. The revised strategy of parallel keyhole work occurring along side the promotional effort worked very well.

Quality Control and Assurance

The restoration quality and workmanship of the core reinsertions was very important for the process promotion. Crews were trained in the proper backfill compaction and proper resetting of the pavement core. A failed core would be extremely detrimental to the project's success. The appearance of the final restoration and the cleanliness of the surrounding areas were also very important. Each core was documented and photographed. A data sheet was filled out that included the location, date, temperature, pavement information, and the like. A tripod-type-device was used to measure the core's vertical relationship to surrounding pavement. A digital photograph was taken of all core reinstatements. Re-inspection of the cores was done occasionally to verify reinstatement stability.

Worksheets from all core reinstatements were entered into a database. In addition, digital photographs were linked to the database. The intent was to be able to track all cores in order to be able to find them in the future. In addition, the database provided a listing of sites that could be visited by the jurisdictions during their evaluation of the process.

Tracking Progress

In addition to individual core restoration database tracking, work progress was tracked and reported on a scheduled weekly basis. Crew costs were also captured and evaluated. Crew productivity was compared and evaluated. Management reporting was conducted on a weekly basis.

In addition, promotion to the jurisdictional agencies was tracked in a project matrix. Progress in primary and secondary jurisdictions was tracked from initial contact, presentation, and demonstration, on to final acceptance.

Part 2: Gaining Jurisdictional Acceptance

Marketing Promotional Approach

Washington Gas adopted a marketing promotional approach in order to promote the keyhole core reinstatement process. The process was unheard of at the jurisdictions and needed to be promoted as something new and beneficial. The process required an enthusiastic salesman-like approach targeting the right people and decision makers in the jurisdictions.

Although WGL's own ultimate focus targeted productivity and cost savings, the benefits to the jurisdiction and traveling public were the focus of the keyhole process promotion. The win/win/win benefits for the jurisdiction, the public and for WGL were emphasized. The jurisdictions are typically concerned with the aspects of traffic control, safety, and restoration integrity. There are many benefits of the keyhole process including:

- Fast process that is typically completed in 4 hours or less
- Reduced exposure time to and inconvenience to road traffic
- No overnight steel plates

- The road cut is very small in comparison to normal excavation
- The cut is consistent and the circular cut prevents cracking
- No jack-hammering is required
- Zero settlement through high shear strength bonding adhesive
- Proven record and 100% guaranteed longevity

The jurisdictions were promised that they would be satisfied with the final restoration. Further, WGL guaranteed that every restored paving core would not fail; otherwise crews would return and repair the site to the jurisdiction's requirements.

Promotional Focus

WGL's franchise area is comprised of over three dozen permitting jurisdictions. A strategy of focusing on the top twelve primary and secondary jurisdictions was adopted. By doing so, 95% of the franchise area would be covered with a lesser amount of promotional energy. Smaller jurisdictions and townships could be approached later as necessary.

For jurisdictional approval, "quick wins" were encouraged. In the early stages, some jurisdictions were more interested in learning about the keyhole process than other larger jurisdictions. Presentations and field demonstrations were rolled out quickly wherever early interest developed. Ultimate approval in these jurisdictions was utilized to help win over the larger jurisdictions. Enthusiastic referrals from jurisdictional engineers were very valuable for the project's promotional success. In many cases, communication across jurisdictions helped promote the success of the project. WGL was actually contacted first in a few cases by jurisdictions that had heard about or seen the process.

Promotional targeting was at two different levels: at a supervisory level and at an engineering level. In the beginning, the focus was primarily on contacting the engineering staff. Unfortunately, this approach did not lead to any success. Only after WGL began utilizing its governmental and public relations (PR) staff, did real progress begin. The strategy changed to having the PR staff approach ranking jurisdictional supervisory personnel. This opened doors allowing the WGL project manager to talk directly with the engineering, permitting, and inspection staffs. The top down approach worked more effectively. Once the doors were open and blessed by the jurisdictional supervisors, the WGL project manager could discuss engineering and construction details with jurisdictional engineers and permitting staff.

Promotional Approach

WGL approached the keyhole process promotion at three different levels by utilizing (1) an introductory package of information, (2) a classroom style presentation, and (3) a field demonstration. The introductory package was first mailed or hand delivered to the jurisdictions. The package contained a cover letter explaining the process and benefits. It included a description and photographs of the process, benefits, trade articles describing the process, process procedures, and Utilibond® grout information and engineering testing data.

Once the introductory package had been submitted, a follow-up call was made to plan the presentation and demonstration. The presentation was important in conveying all the information and answering questions in a quiet and controlled environment. Discussion of the process in the field is difficult due to traffic and equipment noise. The presentation included the keyhole process description, history, process steps, and benefits to the jurisdictions. It was rich with actual photographs of the process and restored pavement core cuts.

Once the classroom presentation occurred, and often on the same day, a field demonstration was conducted. The demonstration was either in a controlled environment (like a parking lot or WGL facility), or at a real job site in the jurisdiction's street. WGL crews paid close attention to variables like traffic control, signage, flagging, safety, and other details during the demonstrations. Process procedures were followed closely. Both the WGL project manager and the crew lead technician explained the steps during the demonstration.

Perseverance

The promotion of the keyhole process took perseverance, time and effort. Even with all the benefits of the keyhole process, immediate acceptance seldom occurred. Each jurisdiction had varying degrees of bureaucracy that needed to be cut through. Even though many liked the process, some jurisdictional contacts did not feel that they had the ability to actually approve the process. Finding either the right decision maker or an internal champion was needed to move approvals forward.

A jurisdictional culture of "old school" restoration methodology often emerged. All the jurisdictions required a "T" section profile restoration with 6" or 12" cutbacks. Since the keyhole core is reset without cutbacks, some engineers had reservations. Other common questions or concerns revolved around proper backfill compaction, bonding grout strength, settlement, longevity, and silt/sediment controls. Continuous reinforcement of the keyhole process benefits and guarantee of longevity was needed to overcome the jurisdiction's concerns. In a few cases, rather than giving full approval, the jurisdictions preferred to provide a conditional twelve-month trial period for the process evaluation. Conditional term approval was considered a project success.

Oddly, there were some jurisdictional engineers that accepted the process to the extreme. They asked that every WGL job be done via the keyhole process. During the presentation, caution was taken not to "over sell" the process. A listing of exactly what could be accomplished through a small hole was stressed.

Extra Work

Additional work and promotion beyond the first presentation and demonstration was often needed for each jurisdiction. Additional presentation(s) and/or demonstration(s) were required if key jurisdictional personnel were unavailable. WGL worked hard to meet the jurisdiction's needs and schedule. Poor weather conditions required rescheduling of field demonstrations.

WGL was required on several occasions to draft language for permitting code changes. The language, references, cross-references, and standard drawings were submitted for jurisdictional review and inclusion in their permitting code.

Jurisdictions often asked WGL to provide references of other areas where the keyhole restoration was approved. References were not only submitted for Washington area jurisdictions, but also for jurisdictions in other areas like Toronto, Canada. In addition, it was common to provide a list of locations where WGL had restored keyhole pavement cores. The jurisdictions would, on occasion, drive across jurisdictional lines to examine some of the earliest WGL restorations.

One of the key components in a successful keyhole pavement restoration was the Utilibond® bonding grout. Therefore, those jurisdictions that had a material testing laboratory often asked for product samples for testing. WGL provided sealed samples of the grout when requested. In addition, one jurisdiction asked for extensive paperwork required for full state approval. In all cases, WGL submitted a promotion package to the lab that included engineering specifications and third party analysis and testing results. Utilicore (and others on the project team) were very supportive in providing assistance, references, and material information to aid the jurisdictions in their evaluations.

Contingency

As discussed above, equipment was chosen for its durability and ability to work on the thick hard streets in the District of Columbia. Good early impressions were necessary during all demonstrations. A failed demonstration due to poor or failed equipment would have been detrimental to achieving the needed approvals. Anyone that has worked in the construction trades knows that there is always a chance for failure. In two of the earliest field demonstrations, mechanical failures occurred on non-keyhole related equipment that could have shut down the demonstration. The problems were quickly repaired and the failure averted, but contingency plans were developed going forward. Planning for future demonstrations included redundant equipment and personnel offsite that could arrive at the jobsite within minutes if needed. WGL did not want to risk loosing time, or more importantly, the jurisdiction's favorable impressions of the process.

Summary and Project Status

The primary focus of the project was to advance the use of keyhole technology at Washington Gas with a focus on gaining jurisdiction approval of cored pavement restoration. The project focused on existing keyhole methods, tools, procedures, and products to effectively work through small holes. To insure success, WG used experienced contractors, service providers, materials and equipment available in the keyhole industry. The primary incentive was cost driven. Keyhole construction and operations techniques are estimated to cost approximately one third to one half of conventional excavation methods.

Keyhole Program Startup Status

The first year of WGL's keyhole operation saw rapid advancement. Keyhole operations were adopted as a major corporate initiative. Both management and staff accepted the new technology and embraced it. Opportunities to try keyhole techniques over conventional excavation methods were often explored. Problems and hurdles were overcome.

An excellent sign of progress was new innovation and ideas. New and creative methods and efficiencies were devised. WGL and the project team devised new keyhole techniques to:

- Encapsulate leaking ¾" and 2" couplings on high pressure steel pipelines
- Set cathodic protection test stations
- Separate and insulate shorted contacts between other utilities
- Replace faulty or paved-over valve, drip, and CP boxes

WGL's alliance contractors expanded the use of vacuum excavation and keyhole techniques. Approximately six contract crews are currently operating. Additional outsourcing is continuing to be developed.

Jurisdictional Approval Status

WGL's franchise area is comprised of over three dozen permitting jurisdictions in the District of Columbia, Maryland and Virginia. In order to maximize project resources and time, focus was directed towards twelve primary and secondary jurisdictions. Smaller jurisdictions and townships will be approached later as necessary. At the date of this writing, six (50%) had fully approved cored pavement restoration. Approvals in three other jurisdictions are pending based on various administrative needs. Contacts with the three remaining jurisdictions are in various stages of development.

The keyhole core reinsertion process was a new concept to each jurisdiction. Each jurisdiction required different levels of energy and time to promote the process. However on the positive side, no jurisdiction disapproved of the process. The approach outlined in this paper has been very successful.

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