North American Society for Trenchless Technology
2008 No-Dig Conference & Exhibition

Dallas, Texas
April 27 – May 2, 2008

Trenchless Cured in Place Watermain Rehabilitation meeting NSF 61

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ABSTRACT:

Topic: Innovations in Potable Water Distribution Trenchless Rehab

This paper addresses the site specific challenges that lie inherent in rehabilitating watermains using the cured in place pipe methods described in ASTM F 1743. This paper shall detail pipe access, bypass and preparation requirements including, all stages of installation from Design thru Pit Placement to Testing of a finished product meeting NSF 61 at a pressure rating of 100 psi. It focuses on a recent case history and documents the installation of a half mile of 8 inch Sanexen Aquapipe in Clinton Township.

A subdivision serving seventy residents was successfully rehabilitated to a new stand alone condition where a municipality had experienced multiple random and unpredictable breaks in a distribution system over several years time. These watermain lines were being utilized beyond their service life (sixty (60) year old cast iron) expectation due to the infeasibility of open cut replacement of pipes on the tree lined streets of the Township.

The benefits of cured in place pipe have been well proven in pressure pipe applications throughout the United States. Due to recent technical developments in the manner in which residential services are reinstated "post lining", watermain has become a viable application. The technology being presented in this paper has been installed over one million feet throughout Canada due to the Consent Decree type pressure being put on Cities by the Federal government to rehabilitate its water distribution infrastructure.

FORWARD:

To date, over 1,000,000 lineal feet of potable water pipelines have been successfully rehabilitated using methods described in ASTM F1743. While in the US focus has remained trenchless application of CIPP in sanitary collection, and pressure transmission applications; Canadian Cities such as Ottawa, Toronto, and Montreal have encountered consent decree mandate style incentives at the Federal level. This has served to create an environment where trenchless technology has been proven to be an optimum means of providing NSF 61certified technology.
Given the tremendous backlog in this country of neglected, leaking and inefficient potable water pipelines, many of which are plainly beyond the service life expectation of their design, owners and engineers are investigating the benefits of cured in place pipe as a water main rehabilitation solution.

In The US; Aqua pipe pilot projects had initially been installed in both Chicago and Atlanta. More recently several Michigan cities had jumped at the opportunity created once MDEQ approval was obtained.

F 1216 vs. F 1743

ASTM F 1216 describes the direct inversion of an impregnated tube into the host pipe to be rehabilitated. ASTM F 1743 describes the pull in place of an impregnated tube followed by the inversion of a secondary constituent known as a calibration hose. The principle advantages of the "pull then invert" method includes resistance to resin contamination, consistency of tube dimension, and assurance of successful installation. Prior to 1995 during which time the direct inversion technology was a proprietary product and not "public domain" ; Lanzo Lining Services and several other key contractors in the US gained millions of feet of F1743 experience installing a product known as Inliner USA. There are over 1,500,000 lf of this material installed within the States of Florida and Michigan alone, albeit with a styrenated resin inappropriate for potable water. With the advent of NSF 61 certified materials which are appropriate in this application; several key contractors stand ready to meet market demand as it arises.

Figure 1. Tree lined streets prohibit open cut methods

Clinton Township

A municipality of about 100,000, the township maintains an aging infrastructure consisting of ductile and cast iron mains as old as 60 years. Inopportune breakage within the extensive water transmission system has caused ongoing emergency conditions at all hours requiring immediate response with emergency point repair at unexpected locations. At great expense the Township has endured this ongoing phenomenon, at times, coinciding with freezing conditions but at all times unexpected and inconvenient. System instability has resulted in system pressure surges as well as sudden drops. The need to stabilize this condition has motivated the township to put in place methods such as pipe bursting, as well as, CIPP while they analyze the advantages of trenchless methods utilized in watermain pipeline rehabilitation. The project described herein, rehabilitated over 3500 lineal feet of cast iron eight inch water main with over seventy services once a fully redundant bypass was installed, chlorinated, tested, and put in service.

The Technology

The emergence of cured in place pipe technology in watermain rehabilitation follows the innovation of internal reinstatement techniques. Previous attempts to utilize CIPP in this application required potholing of each and every service connection. The impractical nature of this approach limited watermain CIPP to trunk transmission, raw water, and only the most special circumstances.
The technology utilized in Clinton Township (Aqua pipe, manufactured by Sanexen Environmental Services., Varennes, Quebec, Canada) is a National Science Foundation (NSF) 61 approved CIPP

product. This product had been successfully used for over five (5) years with over 60 miles of public water main rehabilitated in Canada. The Aqua pipe system is unique in that the material and method provides a watertight seal around the existing service allowing reinstatement of services with minimal digging. Aqua pipe CIPP uses concentric epoxy impregnated jackets that are pulled in place with a winch. The liner is wet out and cured using either steam or hot water. Just prior to lining; installation included robotically inserting a corp. stop isolation. Once the NSF 61 epoxy impregnated liner tube is installed and cured; the plugs are reamed out allowing the services to again be cleared. After the liner is cured, the main is disinfected, sampled, and returned back to service. Presently the range of application is six (6") thru twelve (12") inch in diameter with the average inversion length being approximately five hundred (500') feet.

Site Specific Challenges

The viability of a project includes many variables including:

- ✓ Number and location of access pits required at five hundred foot intervals
- ✓ Fire hydrant location and availability to serve in bypass application
- ✓ In line Tees, Bends and/or Crosses defining additional access pits
- ✓ Line pressure desired (one hundred psi test recommended)
- ✓ Traffic control issues
- ✓ Opportunity to swap out/test meter assemblies

Bypass Operation

A complete bypass consisting of potable water grade flexible hose was strung on both sides of the streets encountered. The lay flat material was wrapped around the driveways in a fashion as to allow driveway access but requiring the resident to drive over this flexible 2 ½ inch material for garage access. Additionally, individual service hoses were strung between the bypass trunks and the individual residents hose bibs, however, not connected prior to the chlorination step. At the conclusion of the stringing and staging of the bypass materials; the system is pressurized and chlorinated with bacteriological testing in accordance with prevailing construction guideline specifications. Prior to bypass activation each meter box is verified for curb stop functionality and part operation. Vacuum breakers were installed at each home encountered. Once Bacteriological Testing is successfully completed, the system is then connected with the curb stops being closed and the hose bibs being opened.

Figure 2. Potable water bypass piping maintaining service to houses

Pit Construction

Access pits measuring approximately 10' long by 5' wide are carefully dug in order to expose the mains with minimal adjacent disruption. Since the bypass is functioning at this point the operation is significant but not critical. The excavation proceeds to approximately 6" beneath the main to be lined. The trench bottom is stoned and dewatered as necessary.

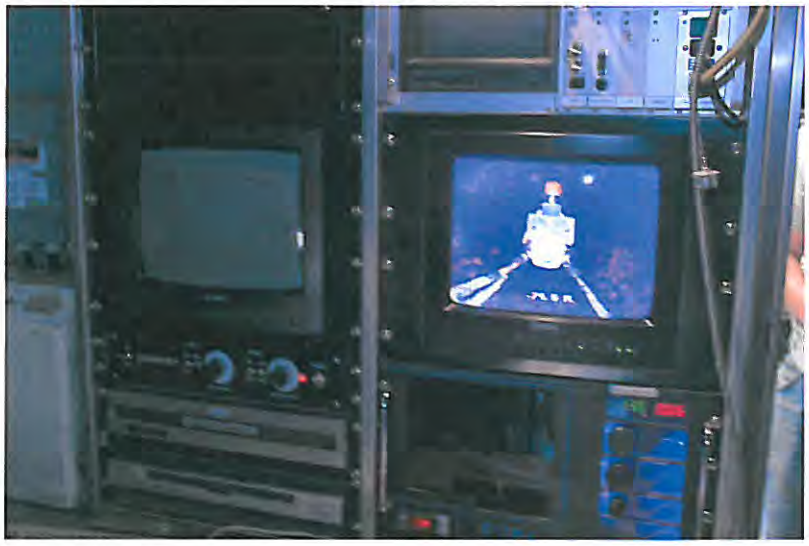

Figure 3. Corp stops are plugged prior to lining

Detuberculation & Pipe Preparation

Unlike sanitary sewer where commonly a soft corrosion byproduct or scale is encountered; watermains are notorious for mineral deposit, tenacious tuberculation, and hard scale. A mechanical reaming device is utilized along with the option of progressive pigging to insure adequate hydraulic radius prior to the lining step. This proceeds at a rate of between fifty and two hundred feet per day although higher productions are at times realized and appreciated! Corp stops are then plugged using a robotic device so that resin is not allowed to seep up into this connection and plug the service. This device also insures location of services for robotic reinstatement once the lining and pressure testing phases are completed.

Figure 4. Tube impregnation

Figure 5. ASTM F 1743 methodology

Pipe Lining

A fully deteriorated stand alone liner capable of withstanding the live loads, dead loads, and internal pressure with a safety factor of two (2) is furnished utilizing site specific criteria in accordance with ASTM F 1216 methods for CIPP Design. Felt/resin composite flexural modulus properties in excess of 500,000psi can be specified and verified using third party testing.
On the jobsite and after CCTV inspection the wet out tube is hoisted in place suing a wench prior to inversion of the calibration hose. Should there be any stretch concerns due to a dry host pipe condition, some residual water may be introduced into the host as a lubricant allowing the tube to more efficiently float into place.
An eight hour cycle time is more than adequate to allow for placement, curing, and end reinstatement. The completion of this step allows for the service reinstatement stage, again not as critical since the system is yet under bypass.
A post video CCTV inspection ensues insuring liner quality and residential service line reinstatement.

Michigan Application and Potential

The tree lined subdivisions of Metro Detroit are not friendly open cut candidates. Especially at unforeseen intervals in sub zero temperatures on an emergency basis. The municipalities polled by this author seemed well acquainted with areas within their respective distribution service areas; where chronic pipe breaks notoriously occurred once winter cold began bearing down on these subdivisions. The opportunity to shore up these lines on a scheduled maintenance basis was welcomed. Recently the MDEQ approved Sanexen Aquapipe as a recognized potable water rehabilitation method and almost immediately 6"-12" jobs were competitively bid in Roseville, Clinton Township, Waterford, Bloomfield Hills and Monroe. A 24" Potable Water Plant intake line was rehabilitated in Mount Clemens using a parallel NSF 61 certified technology installed in January, 2008 by Lanzo Lining Services.

Florida Application and Potential

Some of the most significant failures due to Watermain Freeze have actually occurred in Florida where depth of bury is significantly shallower than in Northern Climbs.
Asbestos cement pipe has been widespread used throughout the State. Both environmental concerns to isolate asbestos as well as water quality issues both weigh on the ongoing utilization of these systems in service.
PCB laden soils, environmentally sensitive excavation sites, and the basic need to minimize disruption will continue to drive the utilization of trenchless technology.

Conclusion

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With continued advance of robotic cleaning and cutting technology, the range of application for cured in place pipe utilized in trenchless NSF 61 listed Watermain rehabilitation will continue to expand.

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