

# **Underground Construction Technology**

## **International Conference & Exhibition**

January 30 - February 1, 2007

George R. Brown Convention Center

Houston, Texas

**Tuesday Jan 30, 2007 Track V = Sewer QA:QC/ Asset Management/  
European & Japanese Quality Standards**

## **QA/QC versus Low Bid: What Should Dictate the Future of the Trenchless Industry?**

by

Gerhard "Gerry" P. Muenchmeyer, P.E.

Director of Engineering & Operations

Reline America, Inc.

*"This session will discuss the trend in the industry towards cheaper and lower cost renewal costs and what the effect is on the long term life of the rehabilitated infrastructure. Life cycle evaluation of different products will be explored to determine its value in the selection of trenchless technologies".*

### **INTRODUCTION**

The Environmental Protection Agency (EPA) estimated, in 2002, that the United States needs to spend \$388 billion dollars over the following twenty (20) years to effectively restore sewer pipe infrastructure that has outlived its useful life and needs to be replaced or renewed. This equates to over \$19.4 billion dollars annually that should be expended and only a little more than \$4.1 billion is actually being spent each year. We are therefore meeting less than 22% of an obligation to provide a safe, disease free environment for future generations.

Trenchless technologies have played a major role by by addressing this need and providing cost effective tools for repairing and renewing the pipe infrastructure in this Country. The majority of the technologies require well trained and experienced labor and specific integrated equipment and products to accomplish the desired results. Only an integrated technology, where the raw materials, the installation requirements and the curing or processing are engineered will consistently produce the same predictable delivered product.

The work that is delivered must be of a sufficient quality to sustain the infrastructure for the future. So what is the expected life of a product? For instance, the expected life for many CIPP & Folded Pipe technologies is

predicted to be 50 to 100 years. But on what basis are these claims made since none of the products have been installed in sewer applications for 50 or 100 years? Products are typically tested by the manufacturer and independent laboratories, but are these tests all that are required? Do these tests adequately reflect longevity claims and do the tests truly reflect all the forces affecting the installed CIPP or Folded Pipe liner?

Sewer system manager's who effectively manage their infrastructure as assets and seek to upgrade their sewer infrastructure in accordance with GASP 34 accounting guidelines, must estimate their life expectancy. The system manager must also certify that the sewer infrastructure will remain in a fully functional state for the projected life and base asset values on good proven product life expectancy. Typically called **ASSET MANAGEMENT**.

## **BACKGROUND**

Since CIPP & Folded Pipe was first introduced, North America has evolved into possibly the largest market for this type of trenchless technology in the world. In the early, 1980<sup>s</sup> & 1990's trenchless lining systems were embraced as the best technology solution for the renewal of sewer infrastructure and predictions were made that the technology would revolutionize the sewer renewal industry. The CIPP & Folded Pipe technologies were truly a major innovation and they did change the way the industry renewed its sewer pipeline infrastructure.

Since the 1990<sup>s</sup>, installation of the CIPP technology has grown significantly while the Folded Pipe market has grown at a slower pace. Today, billions of dollars are being spent, each year, on sewer renewal throughout North America using CIPP & Folded Pipe technology.

Today, when billions of dollars are being spent on pipeline renewal, quality assurance/quality control and testing varies from detailed testing requirements to only CCTV inspection.

The CIPP market has however, emerged from a cost effective, well integrated and engineered quality product, to a commodity driven low price market driven by a low bid mentality while the Folded Pipe technology has generally remained as a quality product, integrated delivery system by specially trained installers.

For over 25 years, these lining systems have provided solutions that address an immense need in the sewer rehabilitation industry.

## **BUT –**

With passing years, original CIPP liner product concepts have changed very little but the quality has diminished. Low bid and market share mentality has become the driving force for many businesses providing CIPP technology services.

With expiration of patent rights in the mid 1990's, CIPP technologies evolved from well engineered and tested products into open commodity-type products driven by competitive prices.

- In lieu of integrated well engineered systems, individual components are now available (off-the-shelf) from multiple sources. Tube materials and resins are generally available for use by anyone wanting to purchase and install these materials.
- Less-demanding project specifications are accepted by customers.
- Reduced levels or no QA/QC, testing and construction oversight is tolerated by the customer.
- Products, in many cases, are now installed by relatively inexperienced installers.
- Faster material curing techniques are being used without extensive testing or documentation of the final product's properties.
- Municipalities are seeking other means of pipe rehabilitation or reverted back to known excavation alternatives.

Low-Dollar Pricing - associated with expanding competition – has become the established procurement method in many parts of the country - displacing emphasis on integrated products, quality and proven product life.

***Lower quality products at a CHEAP PRICE have become acceptable rather than.....***

***Better engineered products at a COMPETITIVE PRICE***

We are therefore challenged to identify what truly is an acceptable level of quality for CIPP and how do we verify that the product is installed correctly.

The future of the CIPP industry must be based on quality product installations that include comprehensive performance based specifications and achievable testing and inspection techniques that are on the highest level. Long term failure modes of installed CIPP products must be evaluated and defined and quality standards that are currently being defined by manufacturers need to be re-evaluated. Academia and government standards must be developed that identify and require the highest possible quality resulting in a better long term predictability of CIPP products.

Without effective national quality standards and testing requirements, to ensure the quality of each CIPP installation and the product life expectancy, what is actually being put in the ground today and the predicted life is questionable.

## **LIFE CYCLE EXPECTATIONS**

Quality and low bid are not necessarily different provided the quality is fully defined as the basis for the low bid.

The quality of the delivered product however, is directly related to the contract specification, the level of quality control and testing that is specified and enforced and the price bid for the work. Contractors will deliver a product at the quality levels specified and within the price bid for the work. Examples can be taken from other industries that offer expensive as well as inexpensive product lines. The expensive products generally last for a longer period of time and will continue to function while the inexpensive product will wear out and will need to be replaced more frequently.

The analysis is a comparison of the initial cost of a product and the expected life of that product. A product with a longer verified useful life often may have a higher initial cost but be more economical over the expected life of the pipe renewal. This evaluation is typically referred to as a life cycle analysis.

The condition a product is sold under will change over time. The product life cycle refers to the succession of stages a product goes through during its effective life. The end of the life cycle occurs when the product no longer functions as originally intended.

Often inadequate, poorly written, specifications, un-enforced testing requirements and limited over-site by inspectors who are not properly trained results in the delivery of a CIPP liner lower in quality than expected by the customer. This will cause the life cycle of a product to be reduced.

As the saying goes **“buy cheap, buy twice”**

Customers generally expect that CIPP will provide a minimum of 50 years or more of renewed life to an old deteriorated sewer pipeline.

## **UNIFORM STANDARDS ARE THEY NEEDED?**

Customers throughout North America have become educated on the poor state of the sewer infrastructure condition and have redirected funding towards the repair and renewal of sewer pipelines. As a result, the CIPP industry has grown significantly over the last 30 years. Over this period of time the selling price for a typical CIPP liner has dropped significantly. This drop in pricing has been due in part to more efficient installation practices, faster curing techniques and in many cases, simply through cut throat competitiveness. High quality competitive pricing is good; cut throat competitive pricing drives the quality down resulting in CIPP liner installations not up to customer expectations.

In more recent years sewer system managers have determined that sewer and water infrastructure must be considered assets. When properly managed and accounted for, these assets can improve the Agency's or Municipality's financial

position. GASP 34 serves as such a guide for evaluating and accounting for these assets. The assets however need to be identified, inventoried and their condition confirmed. Assets in poor condition must be fixed or renewed to take full advantage and the agency or municipality must sign off on the projected life of the asset based on some sound documented basis.

Trenchless Technology is evolving, and competitive bidding and low bid awards, in general, are the normal way for soliciting contracting services for CIPP renewal of old pipelines. The typical acceptance of an installed CIPP liner is through a single visual CCTV inspection after the project is completed. A visual inspection will not confirm the structural capabilities, the chemical resistance or the leak tightness of the installed CIPP.

**No longer can customers rely solely on a visual inspection of the installed liner. A visual inspection provides only a fraction of the data required for predicting the longevity of the liner installed**

## **HOW ARE OTHERS MEETING THE QUALITY CHALLENGE?**

In the European Community the quality of installed CIPP liners has become a major concern. The independent non-profit IKT Institute in Germany has developed a testing protocol that evaluates liner materials that have been taken from the construction site and are then tested and evaluated in a laboratory environment. The testing results accomplished by IKT, in their 2004-2005 Liner Report entitled "The Range is Widening" <sup>1</sup> indicates that the rehabilitation quality range continues to widen between different lining systems installed in Germany. All major German CIPP lining technologies were included in the study and IKT's final report.

Installed systems were also extensively tested to duplicate real world system operating conditions including cleaning the pipe on a regular basis.

Since municipal budgets are shrinking and the need to rehabilitate sewer lines is increasing most system operators are resorting to the lowest available product costs. With manufacturers promising a projected liner life of 50-100 years, consumers in Germany question how the lower cost is affecting the longevity of the liner products. Customers want to know what they are getting for their money.

The German engineering community has reacted by including in their bid proposals, specific Quality Assurance requirements and cities are following suit by including similar requirements in their specifications. In addition advanced training for the sewer rehabilitation industry and information exchange through CIPP trade associations is being extensively promoted.

Testing programs typically include random liner samples, taken from the actual construction site of a project shortly after the liner is cured and then sending

them directly to the selected testing laboratory. The IKT test includes four main categories including elastic modulus, bending tensile strength, wall thickness and water tightness. The results are then compared to the manufacturer's advertised specifications for their systems. In addition a CCTV inspection identifies any defects such as folds, poorly cut lateral connections or other defects that may exist in the newly installed CIPP liner wall.

In many cases technologies are being evaluated based on their estimated longevity. Testing of product samples and their ability to perform under prescribed testing protocol is performed. These results are then entered into a life cycle calculation to determine the projected life of the product. When bids are received for the work the final award is based on documented product longevity in combination with the price bid.

### **CAN WE RECEIVE LOW BIDS AND STILL ACHIEVE THE QUALITY CIPP DESIRED?**

Quality assurance and quality control include the manufacturer who provides the material, the Engineer who prepares the specifications, the contractor who installs the liner. All three must be considered together and included as part of an integrated system to ensure a high quality CIPP liner installation.

***“High quality liner raw materials are worthless if not installed or cured properly. On the other hand a properly cured and installed liner will not meet the quality requirements if the initial raw materials are not high quality”.***

A high quality CIPP liner can be defined as:

- The best quality, proven and tested raw materials manufactured or combined in a quality controlled environment. The level of quality including the raw material, the resin, the fabric tube material, the wet-out procedure, the amount of resin contained in the fabric material, the level of fillers and additives, the curing compounds and the recommended curing technique must be specified and then verified, by the Engineer, before installation by the contractor.
- The installation of the liner must be accomplished, under all application environments, without contaminating the uncured resin and the liner fabric. Groundwater, sewage, hydrocarbons and other contaminants in the ground will react with resins must be kept separated from the uncured resin. Trained installers, with experience in all aspects of CIPP installations must be knowledgeable and consistently install the liner to same level of quality

- The liner must be cured using the best techniques available including thermal and UV light techniques.
- Quality tests must be performed to verify that the installed CIPP liner is structurally sound, has the chemical resistance needed and has a homogeneous leak proof solid pipe wall.

The manufacture of a resin pipe, in the field, under a variety of ground conditions and temperatures is a complicated procedure. For best results, the CIPP technology must be a fully integrated system including fabric, resin, installation and curing. Only integrated systems with a history of successful installations and testing will result in consistent, predictable, product longevity and quality.

Competitive bidding and low bid awards are, in general, the normal way for soliciting contracting services. Low bidding can be effectively used when combined with well written detailed performance specifications that include very specific contract performance requirements, spell out the level of quality to be delivered and clearly require the enforcement of quality and testing.

In some areas of the country, in lieu of low bidding, requests for proposal are becoming more popular for selecting the most qualified and best value for CIPP installations. This approach to awarding contracts however, can be enhanced by providing well written performance specifications, which clearly spell out, a detailed description and performance of the product to be delivered, the full responsibility of the contractor to perform and deliver and the Quality Assurance/Quality Control milestones and testing that will be implemented and enforced.

## **CONCLUSION**

**Quality Assurance/Quality Control and testing can go hand in hand with low bidding requirements.**

### **Performance based specifications – a key to better results**

Performance based specifications that are specific to the intent of the project, the required contractor performance, the Quality Assurance/Quality Controls to be implemented and the testing to be performed must be adopted. Enforcement of the specification's testing requirements is essential for success.

**In addition the following requirements must be included in the performance specifications and must become the basis for testing all CIPP & Folded Pipe liners after installation.**

- Visual CCTV inspection of the installed liner to determine physical appearance and obvious defects..
- Installed liner thickness measurements performed to verify that the design thickness, as specified, has been installed.
- Physical properties of the installed liner are determined from samples taken from the in place liner taken at the construction site and tested by a qualified testing laboratory. A chain of custody must be maintained, by the engineer, for all samples obtained from the construction site.
- The corrosion resistance of the liner is verified by independent third party testing or from samples taken from the construction site and tested by an approved independent laboratory.
- The porosity or water-tightness of the installed CIPP pipe wall is, tested with samples taken from the project site, by the engineer or by an independent laboratory.

**QA/QC versus Low Bid: What Should Dictate the Future of the Trenchless Industry? Low bid selection based on well defined QA/QC and testing requirements included in a well written performance specification will significantly improve the quality of CIPP & Folded Pipe products installed and will ensure that the predicted 50 year or greater life of these technologies are achieved.**

#### References:

1. IKT Liner Report 2004/2005 (CIPP-Liner) entitled "The Range is Widening" by Roland W. Waniek and Dieter Homann, Institute for Underground Infrastructure (IKT)

# Underground Construction Technology

International Conference & Exhibition

George R. Brown Convention Center Houston, TX

## QA/QC Versus Low Bid: What Should Dictate the Future of the Trenchless Industry?

Tuesday January 30, 2007

Track V

Sewer QA/QC/ Asset Management/European & Japanese Standards

By

Gerhard "Gerry" P. Muenchmeyer, P.E.

Director of Engineering & Operations

Reline America, Inc.

# Industry Need

- According to the EPA, **\$388 billion** is required for sewer rehabilitation and **\$274 billion** for water renovation over the next 20 years in this country. That equates to over a **\$33 billion a year need**



2002 EPA Clean Water Needs Survey (CWNS)

# Trenchless Technology



- Is playing a major role in the renewal of the nations infrastructure
- Is delivered with a variety of materials and technology systems; from fully integrated systems to off the shelf commodity products
- Predicted renewal life for CIPP 7& Folded Pipe from 50 to 100 years
- Key element in the renewal of infrastructure for GASP 34 accounting documentation

# Background



- Since its introduction in North America, lining Technology has evolved into one of the largest markets in the world
- Lining technologies have changed the way the industry renews its sewer infrastructure
- CIPP technologies have grown faster than other lining techniques

## **BUT**

- Over the last 30 years CIPP concepts have changed little
- Through commodity offerings and low bidding, the quality of the delivered product has diminished

# US CIPP Liner Industry

- **With the expiration of key patent rights in the early 90's, CIPP lining generally evolved into an open commodity-type market—**
  - Individual components became available (off-the-shelf) from multiple sources
  - Less-demanding specifications were introduced and accepted by customers
  - Reduced levels of QA/QC, testing and construction oversight were promoted and tolerated
  - Installation in many cases was undertaken by relatively inexperienced contractors using unproven curing techniques
  - Some customer have sought other means of pipe rehabilitation

# Result



- Low-Dollar Pricing - associated with expanding competition – has become the established procurement method in many parts of the country - displacing emphasis on integrated products, quality and proven product life.
- **Lower quality products at a CHEAP price have become acceptable rather than developing.....**
- **BETTER ENGINEERED PRODUCTS AT A COMPETITIVE COST**

# The Challenge



- What Is an acceptable level of quality for CIPP liners?
- How do we verify that the product has been installed properly?
- Today, when billions are being spent on pipeline renewal, quality assurance/quality control and testing vary from detailed inspection requirements to only visual CCTV inspection.

# The Future



- Quality based specifications
- Achievable testing and inspection techniques
- Uniform national standards
- Long term predictability of installed products based on verifiable testing
- Life Cycle considerations

# Life Cycle Consideration













