EFCOG BEST PRACTICES – ENVIRONMENTAL

Facility: Hanford Site, Richland Washington

Best Practice Title: Mortar-lining Aged Water Distribution Lines Protects Groundwater and Minimizes Waste

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Brief Description of Best Practice:

The U.S. Department of Energy, Richland Operations Office (DOE-RL) pioneered the application of mortar-lining technology, an innovative, cost-effective, and environmentally friendly solution to restore water distribution lines. The implementation of the mortar-lining project allowed DOE to protect the groundwater, reduce energy use, maintain water quality, minimize waste and ensure the reliability of the fire protection system.

The Hanford Site's successful Mortar-Lining Project is being spearheaded by prime contractor Fluor Hanford and its affiliate Fluor Government Group. Between September 2002 and January 2003, mortar-lining technology was applied to two sections of pipeline, totaling 3,800 feet. This is the initial section of approximately 25 miles of waterline identified as most in need of replacement or rehabilitation on the 586-square-mile Site. The application of mortar-lining is being considered for the pipeline as feasible to support the successful completion of Hanford's environmental cleanup mission, currently projected through 2035.

The mortar-lining process allows DOE-RL to restore rusty, leaky waterlines for about half the cost of installing new ones by applying a thin coat of cement-like mortar to the inside of the existing pipelines. Waterline renovation ensures adequate water for cleanup activities and helps protect the Hanford Site's groundwater.

Why the Best Practice was used:

Hanford water distribution pipes are up to 50 years old. Half are made of unlined iron or steel. Leaks in Hanford's original underground water distribution system cause concern that discharges could move contaminants from the soil into the groundwater. Internal pipe corrosion has degraded fire protection/water supply capabilities that support cleanup activities.

Waterlines were constructed four to 42 inches in diameter for large-volume production facilities that have since closed down, dramatically reducing water flow. Rust and scale favor low-volume flow, encouraging leaks, severely impacting water quality by increasing chlorination requirements, reducing pressure, overworking pumps, and raising energy use and costs.

Typically, waterlines are replaced when they have degraded to the point of leaking. The Hanford Site sought an effective, less expensive alternative for its most degraded pipelines. The mortar-lining process allows us to restore rusty, leaky waterlines for about half the cost of installing new ones by applying a thin coat of mortar to the inside of the existing lines. Waterline renovation ensures adequate water for cleanup

activities and helps protect the Hanford Site's groundwater.

What are the benefits of the Best Practice?

Cost-effective:

- Effectively uses cleanup budget - available funds rehabilitate twice the length of waterline compared to equivalent pipe replacement.
- Extended the service life of the potable water piping section up to 50 years.
- Outsourced service - a local business was contracted to conduct the mortar-lining; it is one of a handful of businesses in the nation providing the technology and expertise.

Environmentally friendly:

- Conserves energy - pumps operate more efficiently due to improved water flow; avoided energy required to manufacture and transport replacement pipes; compared to trench excavation, access-point excavation reduces energy consumed by construction equipment; avoided using energy to transport old pipes to disposal sites.
- Source reduction - conserves natural resources for manufacturing new replacement pipes.
- Minimizes waste - completion of the entire project will avoid solid waste disposal of old, corroded pipes, an estimated 2,640 tons, representing 4,888 cubic yards.
- Minimizes environmental disturbance - excavates only at access points.
- Protects groundwater - eliminates leaks that could spread existing soil contaminants.

Worker and Facility Protection:

- Protects workers - minimal excavation avoids exposure to potentially contaminated soils.
- Improves water quality - pipeline cleanout removes rust and tuberculation (scale build-up) which minimizes ongoing chlorination requirements.
- Improves system operations – results in marked improvement in the operating flow and pressure.
- Restores fire protection systems to desirable operating levels - removes rust and tuberculation that restrict water flow; tuberculation, if not removed, could dislodge, clogging sprinkler heads during high-velocity fire flows.

What problems/issues were associated with the Best Practice?

Few places in the country have trained contractors capable of doing the work. Keeping water service to all of the customers during operations was difficult and in some cases, temporary construction was needed to maintain a continuous water supply.

How the success of the Best Practice was measured:

Based on the waterline projects identified in the water system Master Plan for the next 10 years, savings of approximately $19M are anticipated.

The mortar-lining project was nominated by DOE-RL's Pollution Prevention organization for a new award called The Champions for Environmental Leadership and Green Government Innovation Award. This first-annual award was sponsored by the Environmental Protection Agency's Region 10 office to recognize exemplary environmental practices and projects by federal agencies in Washington, Oregon, Idaho and Alaska. The Mortar Lining Project won the award in July 2003.

Description of process experience using the Best Practice:

The mortar-lining technique is an environmentally friendly, cost-effective, trenchless pipeline rehabilitation process to extend the service life of existing waterlines. The technique has been widely used in the irrigation industry for decades but is only recently being adapted to potable water systems, meeting all water quality standards.

Mortar-lining was field-tested at Hanford in September 2002 on an 1,800-foot section of 8-inch drinking waterline, followed in January 2003 by a 2,000-foot section of 12-inch pipe. As a result of the improvements, flow rates tripled, from 460 gallons per minute (gpm) to 1,403 gpm.

Underground waterlines are excavated at access points every 500 to 700 feet. A remote camera is pulled through the line to assess pipe condition. Where buildup is severe, high-pressure water jets break down the surface scale. A variety of scrapers are pulled through the pipe sections, then piston-like rubber squeegees remove remaining debris.

A proven formula of high-density mortar is prepared and pumped through a hose to the lining head, which applies it to the pipe interior using centrifugal force produced by a high-speed electric motor. A drag trowel is attached to provide a smooth finish to pipes from four to 24 inches in diameter. In larger diameter pipes, the same effect is achieved with rotating multiple trowels. Pump volume and the pulling rates of the lining assembly control the thickness of the lining. Stainless steel trowels follow the lining assembly to produce a very smooth, dense surface. When the mortar is dry, the line is inspected with a video camera, flushed out, filled, sanitized, and returned to reliable, long-term service.

Before Mortar Lining

After Mortar Lining

Web Publishing Information:

Please check the applicable boxes below for the Topical Area(s) to which the Best Practice relates:

- Acquisition Management
- Assessments
- Cyber Security
- Energy Efficiency
- x Engineering
- x Environmental
- Information Management
- Information Security
- x Integrated Safety Management

- x Maintenance
- Management
- Material Control and Accountability
- Nuclear Safety
- Performance Metrics
- Personnel Security
- Physical Security
- Price-Anderson Amendments Act
- Project Management
- Protective Force
- S&S Program Planning and Management
- Standards and Requirements
- x Subcontractor Safety
- x Other Environmental Management System (EMS)

Please check the applicable box below for the Core Function and Guiding Principle to which the Best Practice relates

- Principle 1: Line Management Responsibility for Safety
- Principle 2: Clear Roles and Responsibilities
- Principle 3: Competence Commensurate with Responsibilities
- Core Function 1: Define Scope of Work ; Principle 4: Balanced Priorities
- x Core Function 2: Analysis of Hazards
- x Core Function 3: Develop and Implement Hazard Controls; Principle 5: Identification of Safety Standards and Requirements; Principle 6: Hazard Controls Tailored to Work Being Performed
- Core Function 4: Perform Work Within Controls; Principle 7: Operations Authorization
- x Core Function 5: Provide Feedback and Continuous Improvement