RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Using Robotics Technology to Reline Large Diameter Piping on Steep Slope

Demonstration at the Central Arizona Project (CAP) Mark Wilmer Pumping Plant

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Using robotics equipment has high production rates and safer applications, resulting in shorter downtime.

Mission Issue

By allowing more modern shrinkage reducing admixtures Reclamation can reduce concrete costs during procurement and labor cost by increasing the distance between joints.

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Problem

Relining projects in piping is extremely dangerous, due to inaccessibility, steep slopes, and permit required confined spaces. Incorporating hazardous materials and flammables into the work environment exacerbate the potential for accidents, as observed in the 2007 Cabin Creek fire. In addition, working from platforms on steep inclined surfaces results in slow production rates and high cost, requiring longer work schedules.

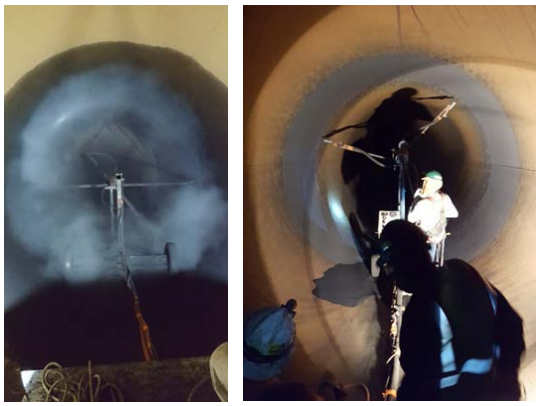
Solution

Contractors have been using robotics equipment since providing better safety, by reducing the number of workers in the permit required confined space, with exposure to hazardous environments. The demonstration project at the CAP Mark Wilmer discharge tubes showed that robotic equipment could be used on steep slope. Eliminating work from platforms on steep inclined surfaces.

Robotics equipment have high production rates allowing for shorter outages, faster return to service, and reduces labor cost. Robotic equipment can be used on pipe diameters up to 32 feet, but may be modified to do any diameter.

Contractors also benefit by using robotics:

- Reduced worker exposure to hazardous conditions or materials
- Reduced cost of PPE
- Reduced number of employees in confined space using ropes access equipment
- Improved surface cleanliness and coating thickness control
- Fewer coating holidays and remedial work
- Reduced blast media and coating material waste
- Reduced fuel consumption
- Faster return to service, moving onto the next job
- Reduced fatigue of employees



Left: Water jet robot removing coal tar enamel. Right: Abrasive blast cleaning robot.

"The physical labor required by employees was reduced significantly because the robots did the majority of the work."

Allen Skaja
Protective Coatings Specialist
Reclamation

Collaborators

Central Arizona Project
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More Information

https://www.usbr.gov/research/projects/detail.cfm?id=8107

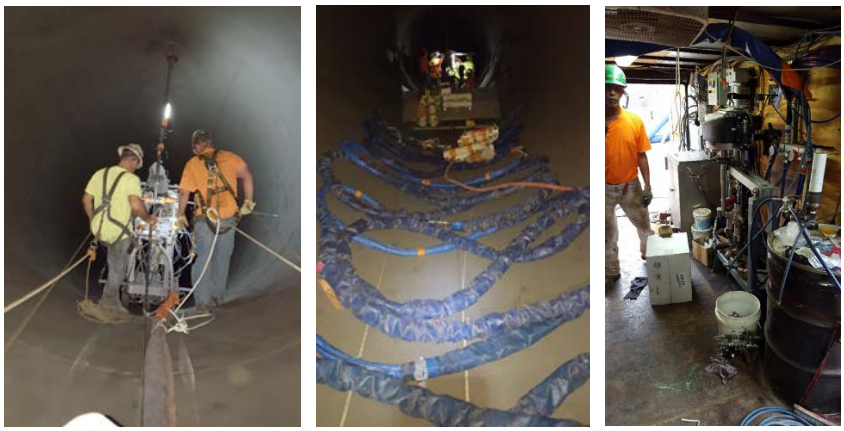
https://www.usbr.gov/research/projects/researcher.cfm?id=859

Application and Results

The Mark Wilmer Pumping Plant discharge tubes were relined within 90 days June 1-August 30, 2016. The total surface area was 105,000 SF. Change in elevation was 824 ft, with inclined surfaces ranging from 16 to 77%. Three different robots were utilized, waterjet robot to remove severely degraded coal tar enamel, abrasive blast robot for final surface preparation, and coating robot to apply a high quality lining.

Future Plans

The next step is to develop an autonomous (person free) robot that is controlled or monitored from outside the confined space work environment. A new research proposal has been submitted to help the technology advance. These advancements could allow for the application of a wider variety of coating systems where safety and health concerns currently preclude their use.



Left: Coating robot setup. Center: Plural component hoses feeding robot. Right: Plural component pump trailer.

Final coating inspection with defect-free, high quality lining.