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**VORTEX**  
industrial

## CASE PROFILE

### AEP NIAGARA HYDRO ELECTRIC PLANT 78" & 66" STEEL PENSTOCKS

#### FAILING PENSTOCKS, STEEP SLOPES MAKE FOR DIFFICULT PIPE REHABILITATION

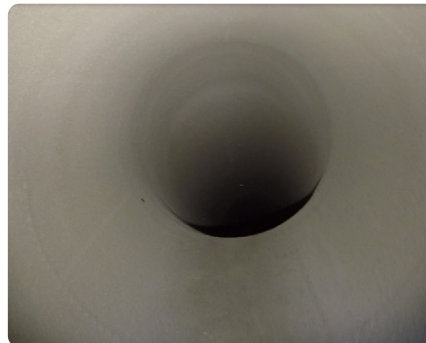
##### SITUATION

The plant's two penstocks — which are the pipes that carry water down from the hydroelectric reservoir to the turbines inside the plant — were compromised with pin holes and weak spots. Each is fed by dual lines, combined into one just before the turbine. One was two (2) 78" in diameter lines totaling 115' long, while the other was one (1) 78" diameter line and one (1) 66" in diameter line, each 57.5' long. The lines had been treated in 1994 with a polyurethane liner... it had failed.

Faced with the decision of whether to replace or rehabilitate the penstocks, plant officials chose the latter. Replacing the penstocks would have been costly because it called for major excavation in a congested area between the plant's Lower Dam and Power House. In turn, the client chose to rehabilitate the penstocks. As part of the process, the deteriorated steel penstock pipes with the failed polyurethane liner would require a full structural restoration.



External view of 45° angled penstocks.



Penstock pipe after GeoKrete® application.



#### SNAPSHOT

**OWNER:**

American Electric Power (AEP)

**FACILITY:**

Niagara Hydroelectric Plant, Vinton VA  
Original construction in mid-1950's

**PROJECT:**

Penstock Restoration

**PENSTOCK DIMENSIONS:**

- 172.50 LF of 78" steel pipe with 45° slope
- 57.50 LF of 66" steel pipe with a 45° slope

**PROBLEM:**

Failing penstock pipes with pre-existing failed polyurethane liner

**RESTORATION METHOD:**

Utilized the Quadex Lining System®

- Spray-applied Quadex® GeoKrete®
- 1" thickness for full structural rehab

**PROJECT TIME FRAME:**

September 18-22, 2017

**INSTALLATION CONTRACTOR:**

Quadex Lining Systems, LLC  
(A Vortex Company)

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Compared to Baseline for  
Trenchless Repair Systems for  
Structural Rehabilitation of  
Civil Infrastructure



## CASE PROFILE

### STEEP GRADES, REMOTE ACCESS REQUIRE VERSATILE LINING SYSTEM AND SOME INGENUITY

Located on a steep slope, Vortex recommended its Quadex Lining System® and GeoKrete® Geopolymer for its ability to be precision spin-cast vertically.

QLS features a highly-portable, custom designed application sled. One of the benefits of using GeoKrete is that it can be pumped long distances. In this case, the mixer, pump and materials were securely position at the top, while the application sled was lowered by cable and winch through the length of the pipe.

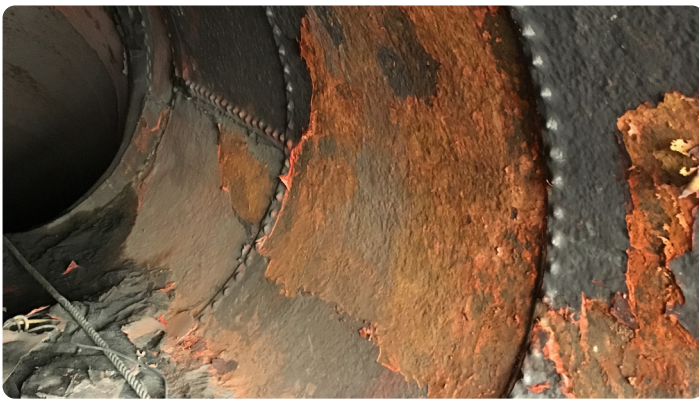
Just as critical as the installation process is the material itself. GeoKrete is considered one of the only “true” geopolymers on the market and is a fully structural, corrosion resistant material that will not crack, peel or degrade over time.

### THE QLS PROCESS

Fortunately the extreme grade of the slope did not effect the installation or typical preparation for lining. Prior to lining, the failed polyurethane liner was removed and the pipe was prepped and patched where necessary. Ready for application, the QLS sled was able to precisely spin-cast the GeoKrete, at a 1” thickness, onto the inner wall of the penstocks. The application sled is winch-controlled to allow for consistent and uniform application throughout the entire length of the pipe.

As a value-added procedure the pipe’s headwall, leading from the penstock, was also GeoKrete lined and shaped.

In closing, although AEP initially selected Vortex for it expertise and breadth of solutions, the crew’s strong safety score was also a factor. This installation proved to be a challenge due to the extreme slope grade. Safety, awareness and special attention to harnessing was paramount.



*Urathane removal was tedious*



*Peering down the steep slope of penstock.*



*Remote access and narrow pathways.*



*GeoKrete Liner - Structural renewal and restored flow capacity.*