TECHNIQUES, MATERIALS AND DESIGN CONSIDERATIONS: REHABILITATION & STRENGTHENING OF WATER AND WASTEWATER PIPELINES

Solutions & Case Studies

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Turnkey Solutions that integrate products, engineering, and construction

- State of the art construction products
- Engineering support services
- Specialty contracting
- Post Tensioning Systems
Specialty Contracting Repair Services

- Concrete Repair
- Strengthening
- PT Repairs
- Force Protection
- Moisture Control & Waterproofing
- Building Envelope
- Historic Restoration
- Pipe Rehabilitation
- Corrosion & Cathodic Protection

**Industrial & Power Generation**

- Delayed coking units
- Sulfur recovery units
- Fluid catalytic cracking units
- Vacuum structures
- Cooling towers
- Water intake structures
- Secondary containment
- Equipment foundations
- Chimneys and stacks
- Tanks
- Silos
- Flue gas path structures
- Intake structures
- Boilers
- Pipe supports
- Circulating water systems
- Hyperbolic cooling towers
- Mechanical draft cooling towers
Comprehensive Repair and Strengthening Solutions

Products & Technologies

- V-Wrap™ FRP Composite Systems
- VSL® Post-Tensioning Systems
- Tstrata™ Enlargement Systems
- DUCON® Micro-Reinforced Concrete used in blast hardening of structures
Repair and Strengthening Solutions

Structural Upgrade with V-Wrap™ FRP Systems

- Light-weight, thin materials with high strength-to-weight ratio
- Rapid installation process
- Code approval - ICC Report (ESR-3261)
- Comprehensive design support
- Fully trained installation crews with extensive experience since 1994
Repair and Strengthening Solutions

V-Wrap™ FRP surface preparation

1. Abrasive blast
2. Dustless grinding & vacuum
3. Water blast & dry

Open pores for mechanical bond

Primer
Material Selection

Epoxy highlights

- Two-part
- Ambient cure thermoset
- 100% solids
- VOC compliant
Repair and Strengthening Solutions

V-Wrap™ FRP saturation process
Repair and Strengthening Solutions
V-Wrap™ FRP QA/QC

ASTM D4541

ASTM D3039
Pipe, Culvert & Tunnel Rehabilitation

- **Products**
  - XPT™ Post-Tensioning System
  - V-Wrap™ Carbon Fiber System
  - StrongPIPE™ Hybrid FRP
CFRP Repair of Pipe

- Widely preferred method
- No excavation
- Standalone
- Fast
- Targeted or continuous repairs
- Emergency repairs
- Specialty repair in confined space
- Environmental controls
- Cost
CFRP Liner Installation

Laydown Area

Environmental Controls

Typical Mix-Tent
CFRP Liner Installation
CFRP Liner Installation

Termination Detail
CFRP Liner Installation

Termination Detail
CFRP Liner Installation
Project Overview: 102-inch PCCP

NRG Limestone Station Unit 1
Jewett, TX

- Coal Fired Power Station
- 1706 MW
- 102-inch PCCP CWS
- 35 PSI operating pressure.
- No condition assessment performed on CWS.
- 2010 added Surge Tower to alleviate transient pressures.
Project Overview: 102-inch PCCP

NRG Limestone Station Unit 1
Jewett, TX

- Dec. 2014: Unplanned Outage Due to Pipe Failure on CWS.
- Emergency pipe inspection performed.
- Phase 1: Dec 18 - Dec 24, 2014 V-Wrap Carbon Fiber utilized for Emergency Repairs on initial 2 segments, grew to 7 segments of 102-inch PCCP.
Project Overview: 102-inch PCCP & 72-inch Steel

NRG Limestone Station Unit 1
Jewett, TX

- Phase 2: Spring 2015 Internal CFRP repairs of 7 sections of 102” PCCP & one section of 72” carbon steel pipe.
- Inspection of pump pit wall leaks and development of repair options for remediating leakage.
- Chemical grouting and concrete repair at the pump pit walls.
- 18 days
- Total Project Cost: $1.56M
Project Overview: 24-inch Carbon Steel

Exelon Generation Muddy Run

Internal Pipe Repair: Carbon Steel Penstock Drain Line
Project Overview: 24-inch Carbon Steel

Exelon Generation Muddy Run

Internal Pipe Repair: Carbon Steel Penstock Drain Line
Project Overview: 18-inch RCP to Steel

NRG Etiwanda Station

External Pipe Repair: Reinforced Concrete to Steel Pipe Connection
Project Overview: 18-inch RCP to Steel

NRG Etiwanda Station
Project Overview: 18-inch RCP to Steel

NRG Etiwanda Station
Rehab Options: StrongPIPE Hybrid FRP System

- StrongPIPE is used when pipe cannot be excavated and is ideally suited for extended runs requiring fully structural repair.
StrongPIPE system utilizes a continuously wound high strength deformed steel wire embedded in a epoxy matrix, placed inside the existing pipe.
StrongPIPE Hybrid FRP System Installation

Installation Overview - Reinforcing Steel
During their spring outage the client inspected their 78” pipeline and noticed a large crack with water spraying into the pipeline and another large bulge in the line about 60’ away.

The crack and bulge were caused by piles being driven into the ground.

Client decided to go with the full 60’ repair (3 x 20’ long pipe sections).
Project Overview: 78-inch PCCP

Mill Creek Generating Station: Jefferson County, KY

- We stopped the water by chemical injection and then client personnel welded a plate over the crack.
Project Overview: 78-inch PCCP

Mill Creek Generating Station: Jefferson County, KY

- We installed StrongPIPE wire system which took 2 days.
- Full project duration was under 2 weeks long.
Carbon Fiber Technical Overview

Design Considerations Overview

- Internal working pressure
- Internal working-plus-transient pressure
- Weight of pipe and fluid
- Earth load above the pipe
- Live loads at the ground surface
- External pressure due to groundwater above the pipe
- Negative pressure inside the pipe
- Thrust
- Combined loading effect
- Thermal effect
- Joint details
- Differential stiffness near wire break zone (PCCP)
- Other Considerations
- Water-tightness

What is the desired service life?
Resources

- Specialty Products
- Design Support
- Construction Budgets
- Forensic Support
- Specifications and Material Selection

Contracting Services
- Concrete Repair & Strengthening
- Post Tensioning Systems
- Corrosion Prevention Systems
- Moisture Control Systems
- Building Envelope Repairs
Questions?

Current Projects?

Thank You!