City of Irving
48” MacArthur Line Repair
With Carbon Fiber Wrap Materials

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Thanks to Todd Reck and Steve Pettit (City of Irving) for assistance with project pictures and background details
PROJECT BACKGROUND

- 48” PCCP Leak in January 2017
- Major crossing under George Bush Tollway (Hwy 161)
- Multiple water lines made it difficult to determine leak source
- Limited access to excavate
- Potential loss of water to businesses and restaurants
- Potential loss of power to Las Colinas Medical Center
PROJECT BACKGROUND

- Leak located by leak detection contractor in area of major underground utilities and access road
- Dewatered and manways constructed for forced air and ventilation.
- Pipe Segment (16 Feet Each) Identified with Wire Breaks and temporary weld repairs completed.
PROJECT LOCATION
• Permanent repairs completed with CFRP
• Emergency mobilization for CFRP completed in 1 week to avoid additional shutdown
• Total repair time approximately 2 months
INTRODUCTION TO FRP

• Carbon Fiber Reinforced Polymers (CFRP)

• Glass Fiber Reinforced Polymers (GFRP)
CARBON FIBER REINFORCED POLYMER (CFRP): UP-CLOSE
TRADITIONAL APPLICATIONS
Column, Beam, Slab, Wall, and Tank Strengthening
PRESSURE PIPE REPAIR OPTIONS

External Repairs

CFRP Rehabilitation

Replacement
TYPICAL CFRP ENVELOPE

Diameter Range:
Medium – Large
30” – 252” (Internal)

Pressure Range:
Up to 400+ psi
Vacuum Pressure (to 14.7 psi)
OVERVIEW OF PROJECT PROGRESSION

Post FRP Installation

Post Condition Assessment

Green	RED	Green

Green	Green
AWWA C305 DESIGN REQUIREMENTS

**Hoop Direction**

- **Burst Pressure**
- **Pipe Deflection**
- **Constrained Buckling**

**Longitudinal Direction**

- **Poisson’s Effect**
- **Temperature Change**
- **Thrust Loading**
STEP 1: SURFACE PREPARATION

Sand Blasting Equipment

Finished Surface - Concrete
STEP 2: PRIMER / SATURATION

Surface Primer

CFRP Impregnation

Material Transport
STEP 3: FRP SYSTEM INSTALLATION

Circumferential layer

Completely Installed FRP System
STEP 4: TYPICAL TERMINATION DETAIL

- Spigot End
- Bell End
- PCCP
- 2:1 Slope of Epoxy Mortar
- GFRP - Dielectric Barrier
- CFRP - Long Direction
- CFRP - Hoop Direction
- Top Coat of Thickened Epoxy
- Epoxy Mortar
- Bond Length Required to Develop Forces
FIELD QC – MOCK-UP PANEL TESTING

- Minimum (3) 2 ft. x 2 ft. panels on adjacent non-repair pipes
- Prepared and tested by Installer (ASTM D4541)
- Witnessed by Inspector
- >200 psi required for at least 3 tests per panel
TESTING OF WITNESS PANELS

• Prepared by the Installer, witnessed by the Inspector, tested by the Independent Testing Agency
• Typically two-panels per day per work shift
• Typically two-layers unless otherwise specified
• Preparation of panels spread throughout construction
• Mean tensile strength and modulus obtained per ASTM D3039 should be greater than the characteristic values used in design
QUESTIONS?

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