Case Histories *(High Pressure Line Pipe)*

**Line Pipe - High Pressure**

**Application**  
High Pressure Water and CO₂ Injection Line Pipe, 1992

**Location**  
Dollarhide Field, West Texas

**Product**  
2”, 2500 psi Aliphatic Amine Line Pipe, 8rd Integral Joint connection

**Quantity**  
22,000 feet

**Service Conditions**  
Began 1992 on 17 Injection Wells, 1997 converted 5 wells to CO₂. 
2001 - Converted 5 wells on CO₂ back to water
2002 - Converted same 5 wells back to CO₂
2003 - Converted all 17 wells to 100% CO₂

**Conditions: CO₂**  
Flow Rate: 500,000 to 1,000,000 cubic feet per day
Pressure: 1900 psi
Temperature: 70°F - 80°F

**Conditions: Water**  
Flow Rate: 300 to 400 barrels per day
Pressure: 2000 psi
Temperature: 70°F - 80°F

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**Line Pipe - High Pressure**

**Application**  
Flow Lines, 2004

**Location**  
Kazakhstan

**Product**  
Oil Line Service
- 12”- 1000 psi STAR Super Seal (4,980 meters)
- 10”- 500 psi STAR Super Seal (1,080 meters)
- 8”- 1500 psi 8rd Aliphatic Integral Joint (8,631 meters)
- 3 ½”- 1500 psi Aliphatic Amine Integral Joint (545 meters)

**Water Line Service**
- 10”- 1250 psi STAR Super Seal (8,266 meters)
- 8”- 1500 psi 8rd Aliphatic Amine Integral Joint (6,900 meters)
- 6”- 1500 psi 8rd Aliphatic Amine Integral Joint (1,885 meters)
- 3 ½”- 1500 psi 8rd Aliphatic Amine Integral Joint (545 meters)

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**Line Pipe - High Pressure**

**Application**  
Fiberglass flowlines proved effective for replacing corroded carbon steel

**Location**  
Norman Wells, Alberta Canada (75 miles south of the Arctic Circle)

**Product**  
3” and 4”, 2000 psi Aliphatic Amine Line Pipe, Integral Joint connection

**Quantity**  
5 Miles

**Service Conditions**  
STAR Series 2000 was used to replace carbon steel pipe that was in service only 3 years.
Line Pipe - High Pressure

Application
High Pressure Water Injection Line Pipe

Location
Kurten, Texas

Product
1½" (2 3/8" EUE 8rd) through 4" (5½" OD 8rd) 4000 psi Line Pipe, Threaded and Coupled

Quantity
- 57,000 feet 1½" (2 3/8")
- 29,000 feet 2" (2 7/8")
- 19,600 feet 2½" (3 ½")
- 17,200 feet 3" (4 ½")
- 19,700 feet 4" (5 ½")

Service Conditions
- Installation date 1984
- Buried 3 feet deep
- Fresh water injection
- Candidate for CO₂ injection
- Operating pressure 3200 psi
- Operating temperature 140°F

CO₂ Test
The project started in October of 1981 and ended August 1984. The test consisted of 4 injector wells and one INSTALLATION producer. Three of the injection wells were completed with steel line pipe, which corroded causing problems and the fourth well was 2" 3500 psi STAR fiberglass pipe. The STAR pipe has operated trouble free to this date. The four wells are still injecting fresh water into the Woodbine C sands. The 100% CO₂ was injected at 2800 to 2900 lbs as a liquid, with a operating temperature of 150°F maximum at a rate of 20 to 750 barrels per day. The CO₂ was injected a total of eight different times for periods of one week to four months at a time during the 35 month project. The fresh water used in this pilot was injected at the same pressure with a operating temperature of 130°F at 40 to 260 barrels per day. The project was cancelled due to the cost of CO₂ and the break through into other sands.

Line Pipe - High Pressure

Application
High Pressure Fiberglass Water Injection System Replaces Steel

Location
Big Wells, Texas

Product
2" 2000 psi and 2500 psi Injection Line Pipe

Quantity
Since 1978, virtually all injection lines have been replaced. Originally a 2000 psi product was used, but since then the operating pressure has increased to 2100 psi, the field began to use the 2500 psi product about 1987.

Service Conditions
- Injection Pressure 2100 psi
- Operating Temperature 100°F Maximum
- Produced Water, 4-13 PPM H₂S, Oxygen content 0 to .3 PPM

Observation
There has been concern in the industry over the long-term lifetime of fiberglass line pipe operating at or above the manufacturer's rating. In 1987 a 2" 2000 psi sample was provided by the customer from this system that was eight years old. The sample was evaluated and found to show no significant change in the ultimate weep pressure or elastic properties from new production pipe.
**Line Pipe - High Pressure**

**Application**
High Pressure Water/CO$_2$ Injection (WAG) and Flow Lines

**Location**
Camirick Field - Perryton, Texas

**Product**
Flow Lines: 3” 1000 psi, Aliphatic Amine Line Pipe  
4” 1000 psi, Aliphatic Amine Line Pipe  
6” 500 and 1000 psi, Aliphatic Amine Line Pipe

**Quantity**
80,000 feet

**Service Conditions**
Operating Pressure: 250 psi (500 Series pipe)  
600 psi (1000 Series pipe)  
Operating Temperature: 100°F

**Product**
Water/CO$_2$ Injection: 3”, 4” and 6” 2000 psi, Aliphatic Amine Line Pipe

**Quantity**
100,000 feet

**Service Conditions**
Operating Pressure: 1300 psi (2000 Series pipe)  
Operating Temperature: 110°F

**Observation**
Water/CO$_2$ Injection (WAG) - A method used to boost oil production in existing oil fields by injecting alternating water and gas (carbon dioxide) into injection wells resulting in extending the production life of the field.

NOV Fiber Glass Systems has been replacing and installing new fiberglass line pipe since 2000 with Aliphatic Amine line pipe.

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**Line Pipe - High Pressure**

**Application**
High Pressure Fiberglass Line Pipe selected for two South Louisiana waterfloods

**Location**
Denheim Springs, Louisiana

**Product**
2” (2 7/8”) 3000 psi Line Pipe - 40,000 feet  
4” (5 1/2”) 3000 psi Line Pipe - 44,000 feet  
Various 2 7/8” and 5 1/2” 3000 psi STAR Fiberglass Fittings

**Service Conditions**
Year of installation 1985; Salt water injection system  
Operating Pressure 1800 psi; Operating Temperature Ambient

**Location**
2” (2 7/8”) 4000 psi Line Pipe - 28,000 feet  
4” (5 1/2”) 4000 psi Line Pipe - 28,000 feet  
Various 2 7/8” and 5 1/2” 4000 psi STAR Fiberglass Fittings

**Service Conditions**
Year of installation 1986  
Buried under 3 feet of cover  
All the fittings were thrust blocked  
Salt water injection service  
Operating Pressure 1500 psi  
Operating Temperature Ambient
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### Line Pipe - High Pressure

**Application**  
Fiberglass Line Pipe Battles $\text{H}_2\text{S}$ and $\text{CO}_2$ Corrosion

**Location**  
Near Red Deer, Alberta Canada

**Product**  
- 3” 800 psi Line Pipe - 50,000 Feet
- 4” 2000 psi Line Pipe - 12,000 Feet
- 6” 1250 psi Line Pipe - 42,000 Feet

**Service Conditions**  
- Flow Lines 400 psi at 120°F
- Injection Lines 1400 psi at 120°F
- Produced Oil and Water
- $\text{H}_2\text{S}$ and traces of $\text{CO}_2$ are present

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### Line Pipe - High Pressure

**Application**  
Water Injection Systems began in mid 1992

**Location**  
Oklahoma City, Oklahoma Airport

**Product**  
3500 psi Line Pipe, 8rd

**Quantity**  
- 2” 3500 psi Line Pipe - 40,000 Feet
- 2 1/2” 3500 psi Line Pipe - 40,000 Feet
- 3 1/2” 3500 psi Line Pipe - 100,000 Feet
- 4” 3500 psi Line Pipe - 25,000 Feet

**Service Conditions**  
- Water Injection System
- Operating Pressure 1750 psi
- Operating Temperature 100°F

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### Line Pipe - High Pressure

**Application**  
Produced Saltwater Injection System

**Location**  
Friendswood, Texas

**Product**  
3” 2000 psi Line Pipe, Integral Joint

**Quantity**  
60,000 Feet installed in 1991,  10,000 Feet installed in November 1993

**Service Conditions**  
- Produced Saltwater
- Operating Pressure 1500 psi
- Operating Temperature 110 to 120 Degrees

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### Line Pipe - High Pressure

**Application**  
Injection Trunk Line

**Location**  
N. Cowden, Texas

**Product**  
8”, 10” & 12” Tested to 1400 psi Super Seal Line Pipe

**Service Conditions**  
- Operating Pressure: 1100 - 1200 psi
- Operating Temperature: 90°F
Line Pipe - High Pressure

Application: Water Injection with H₂S
Location: Fittstown, Oklahoma (East Fitts Field)
Product: 4", 6" & 8" 2000 psi Aliphatic Amine Line Pipe
Service Conditions: Operating Pressure: 1960 psi
H₂S: 0.2 Dissolved
PH: 5.8

Line Pipe - Natural Gas

Application: Production Flowlines
Location: Freer, Texas
Product: 3" and 4" 1500 psi Line Pipe (Standard Design)
Quantity: Ongoing project, more than 150,000 feet of 3" and 30,000 feet of 4" Pipe and Fittings
Service Conditions: Natural Gas with CO₂ present
Operating Pressure 900 psi
Operating Temperature 110°F

Line Pipe - Natural Gas

Application: Gas Production Flowlines
Location: Big Wells, Texas
Product: 3 ½" 2000 psi Line Pipe, Integral Joint
Quantity: 7,500 Feet and 4,800 Feet
Service Conditions: Operating Pressure 1800 psi
Shut-In Pressure 2000 psi
Operating Temperature 80°F
Produced Gas, Water and Condensate
1% H₂S (9 PPM), Chlorides (120,000 PPM)

Line Pipe - Natural Gas

Application: Sour Gas Production Flowlines inserted inside steel
Location: Grand Prairie - Alberta, Canada
Product: 3" 2000 psi Line Pipe
Service Conditions: Natural Gas with 28% H₂S
Operating Pressure 1400 psi
Operating Temperature 150°F
**Line Pipe - Natural Gas**

**Application**
South Texas Field solves H₂S and CO₂ Corrosion and Erosion problem installed in 1993

**Location**
Zapata, Texas

**Product**
2", 2 1/2", 3", and 4" 1500 psi Line Pipe
More than 50,000 feet of 2"
More than 120,000 feet or 3"
More than 50,000 feet of 4"

**Service Conditions**
Natural Gas Production Lines; 5 to 6% CO₂; Operating Pressure 110°F to 190°F
1000 to 1200 psi Gas Production 10 MCFD; Condensate 400 BPD
Velocity 60 to 70 feet/second; sales line pressure - 980 psi

**Erosion Test Line**
The 2" steel line (double extra heavy) was being replaced on a regular basis due to corrosion and erosion problems. The line contains 90º elbows which further enhanced the erosion problems. Currently, the fiberglass line pipe has outlasted the steel 3 times. Flow rate 3.2 MCFD Operating Temperature 110°F to 120°F; Operating Pressure 1000 psi; Traces of 20 to 40 Grit Sand.

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**Line Pipe - Natural Gas**

**Application**
Onshore Gas Field uses FRP to fight corrosion problems

**Location**
Rehden, Germany

**Product**
3" 800 psi Line Pipe IJ

**Quantity**
7,300 Feet (2,200 meters)
Installed January 1995

**Service Conditions**
Natural Gas
Water Condensate (Waco Saltwater)
Design Pressure 232 psi (16 Bar)
Operating Pressure 14.5 to 232 psi (1 to 16 Bar)
Operating Temperature 176°F (80°C)
Working Temperature 140°F (60°C)

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**Line Pipe - Natural Gas Production with CO₂**

**Application**
Flowline installed in 1991

**Location**
Fowlerton, Texas

**Product**
2 1/2" and 3" 1500 psi Line Pipe

**Service Conditions**
Operating Pressure 650 psi
Operating Temperature 100°F to 110°F
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