

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 Started water injection in 1992 on 17 Injection Wells, in 1997 converted 5 wells to CO₂. The remaining 12 well continued water injection.
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

CONDITONS: 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

LP-022
ISSUED 12/14/05**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 1/2", 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 1/2", 1500 psi 8rd Aliphatic Amine Integral Joint (545 meters)

SERVICE

LP-023
ISSUED 12/14/05

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" (3½") 17,200 feet 3" (4½") 19,700 feet 4" (5½")
SERVICE CONDITIONS	Installation date 1984 Buried 3 feet deep Fresh water injection Candidate for CO ₂ 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% CO ₂ was injected at 2800 to 2900 lbs as a liquid, with a operating temperature of 50°F maximum at a rate of 20 to 750 barrels per day. The CO ₂ 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 CO ₂ and the break through into other sands.

LP-005
ISSUED 01/22/97
SUPERSEDES 9/11/9

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	Unknown, 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	Injection Pressure 2100 PSI Operating Temperature 100°F Maximum Produced Water, 4-13 PPM H ₂ S, 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.

LP-001
ISSUED 01/22/97
SUPERSEDES 09/11/90

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass flowlines proved effective for replacing corroded carbon steel

LOCATION Norman Wells, Alberta Canada (75 miles south of the Artic Circle)

PRODUCT 3" and 4", 2000 psi Aliphatic Amine Line Pipe, Integral Joint connection

QUANTITY 5 Miles

SERVICE
CONDITIONS

CO2 TEST

LP-024
ISSUED 12/14/05

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 Unknown, 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 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.

LP-001
ISSUED 01/22/97
SUPERSEDES 09/11/90

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" (5½") 3000 PSI Line Pipe - 44,000 feet
Various 2-7/8" and 5½" 3000 PSI Star Fiberglass Fittings

SERVICE Year of installation 1985; Salt water injection system
CONDITIONS Operating Pressure 1800 PSI; Operating Temperature Ambient

LOCATION 2" (2-7/8") 4000 PSI Line Pipe - 28,000 feet
4" (5½") 4000 PSI Line Pipe - 28,000 feet
Various 2-7/8" and 5½" 4000 PSI Star Fiberglass Fittings

SERVICE Year of installation 1986
CONDITIONS Buried under 3 feet of cover
All the fittings were thrust blocked
Salt water injection service
Operating Pressure 1500 PSI
Operating Temperature Ambient

LP-002
LP-003
ISSUED 01/22/97
SUPERSEDES 02/01/93

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass Line Pipe applications in Michigan

LOCATION Marion, Michigan
Falmouth Field

APPLICATION Flowlines 1978
2" 3000 PSI Line Pipe - 50,000 feet
Working Pressure 3000 PSI, Temperature Ambient

Fresh Water Injection 1978
1½" 2000 PSI Line Pipe - 25,000 feet
Working Pressure 40 PSI, Temperature Ambient, Shut-In Pressure 300 PSI

Fresh Water Injection 1983
1½" 3500 PSI Line Pipe - 8,000 feet
Working Pressure 3280 PSI, Temperature Ambient

LOCATION Winterfield, Michigan

APPLICATIONS Flowlines 1978
2" 3000 PSI Line Pipe - 60,000 feet
Working Pressure 3000 PSI, Temperature Ambient

Fresh Water Injection Lines
1½" 2000 PSI Line Pipe - 25,000 Feet
Working Pressure 40 PSI operating, Temperature Ambient, Shut-In Pressure 300 PSI

Fresh Water Injection 1988
1½" 3500 PSI Line Pipe - 5,000 feet
4" 3500 PSI Line Pipe - 2,500 feet
Working Pressure 3360 PSI, Temperature Ambient

LP-004
ISSUED 01/22/97
SUPERSEDES 05/11/93

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass used for Production Flowlines

LOCATION Hawkins, Texas

PRODUCT 3" 1650 PSI and 2000 PSI Line Pipe, Threaded and Coupled EUE 8rd

QUANTITY 200,000 Feet

SERVICE
CONDITIONS Began Production Flowlines in 1985
Operating Pressure 300 PSI
Shut-In Pressure 1800 PSI
Operating Temperature Ambient
Production contains nitrogen gas which the field injects for stimulation.
Production is highly corrosive to steel and coated steel.

LP-009
ISSUED 01/22/97
SUPERSEDES 09/11/90

LINE PIPE - HIGH PRESSURE

APPLICATION Production and Injection Cold Weather Installation

LOCATION Judy Creek - Alberta, Canada

QUANTITY Ongoing project since July 1993. Up to 60,000 meters in service to date.

FLOWLINES 3", 4", 6" and 8" 800 to 2000 PSI Line Pipe API 15HR Design

SERVICE
CONDITIONS Produced oil and salt water, traces of H₂S
Field tested at 2750 PSI
Operating Pressure 1750 PSI
Operating Temperature 80°C (176°F)

LP-020
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass Water Injection System installed in June 1992

LOCATION Sundown, Texas

PRODUCT 6" 2000 PSI Line Pipe. Integral Joint

QUANTITY 10,000 Feet installed in 1992, 5,000 Feet installed in 1994.

SERVICE
CONDITIONS Produced Water Injection
Operating Pressure 2100 PSI
Ambient Temperature 80°F

LP-013
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass Water Injection System installed in October 1992

LOCATION Chickasha, Oklahoma

PRODUCT 2½" 3000 PSI Line Pipe, Integral Joint - 30,000 ft.
3" 3000 PSI Line Pipe, Integral Joint - 50,000 ft.

QUANTITY 52 Wells completed in 1987, 44 Wells completed in 1989, total footage 576,000

SERVICE Produced Water Injection

CONDITIONS Operating Pressure 2650 PSI
Operating Temperature 110°F maximum, 130°F at supply well

T-002
ISSUED 01/22/97
SUPERSEDES 09/11/90

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass Water Injection System

LOCATION Welch, Texas

PRODUCT 2" 2500 PSI Line Pipe
3" 2500 PSI Line Pipe

QUANTITY More than 100,000 Feet combined footage installed since 1991

SERVICE Produced Water Injection

CONDITIONS Operating Pressure 1400 PSI
Operating Temperature 80°F Maximum

LP-015
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION High Temperature Multi-Phase Flowlines

LOCATION Harmattan - Alberta, Canada

PRODUCT 2", 2½", 3", 4", and 6" 800 PSI to 1250 PSI Line Pipe

QUANTITY Ongoing project started in 1994, up to 40,000 meters in service

SERVICE Operating Pressure 800 PSI to 1250 PSI

CONDITIONS Operating Temperature 180°F

LP-021
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION High Temperature Multi-Phase Flowlines

LOCATION Simonette - Alberta, Canada

PRODUCT 3", 4", and 8" PSI Line Pipe

FOOTAGE Ongoing project started in 1992, up to 22,000 meters installed

SERVICE Operating Pressure 800 PSI

CONDITIONS Operating Temperature 180°F

LP-010
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION Fire Water Line
LOCATION Oman - October 1992
PRODUCT 6" 800 PSI Line Pipe, Threaded and Coupled - 560 Feet
8" 800 PSI Line Pipe, Threaded and Coupled - 4000 Feet
Various Star Fiber Glass Fittings
SERVICE Fire Water/Foam Solution Piping, Test Pressure 363 PSI
CONDITIONS Design Operation Pressure 235 PSI
Operating Temperature 180°F

LP-011
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION Fiberglass Line Pipe Battles H₂S and CO₂ 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 Flow Lines 400 PSI at 120°F
CONDITIONS Injection Lines 1400 PSI at 120°F
Produced Oil and Water
H₂S and traces of CO₂ are present

LP-012
ISSUED 01/22/97

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
2½" 3500 PSI Line Pipe - 40,000 Feet
3½" 3500 PSI Line Pipe - 100,000 Feet
4" 3500 PSI Line Pipe - 25,000 Feet
SERVICE Water Injection System
CONDITIONS Operating Pressure 1750 PSI
Operating Temperature 100°F

LP-010
ISSUED 01/22/97

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 Produced Saltwater
CONDITIONS Operating Pressure 1500 PSI
Operating Temperature 110 to 120 Degrees

LP-016
ISSUED 01/22/97

LINE PIPE - HIGH PRESSURE

APPLICATION 1.5 MILLION FEET installed since 1998
LOCATION South Texas
PRODUCT 4" 1500 PSI Line Pipe, Intregal Joint
6" 1500 PSI Line Pipe, Intregal Joint
3" 2000 PSI Line Pipe, Intregal Joint
4" 2000 PSI Line Pipe, Intregal Joint
SERVICE Up to 2% CO₂
CONDITIONS Operating Pressure: 950 - 1200 PSI
Operating Temperature: 4"-6" 1500 PSI, 110° to 120° F.
3" - 4" 2000 PSI, 140° to 175° F.

LP-023
ISSUED 08/28/02

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 Operating Pressure: 1100 - 1200 PSI
CONDITIONS Operating Temperature: 90°F

SS-001
ISSUED 08/28/02

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 Natural Gas with CO₂ present
CONDITIONS Operating Pressure 900 PSI
Operating Temperature 110°F

LP-018
ISSUED 01/22/97

LINE PIPE NATURAL GAS

APPLICATION Gas Production Flowlines
LOCATION Big Wells, Texas
PRODUCT 3½" 2000 PSI Line Pipe, Integral Joint
QUANTITY 7,500 Feet and 4,800 Feet
SERVICE Operating Pressure 1800 PSI
CONDITIONS Shut-In Pressure 2000 PSI
Operating Temperature 80°F
Produced Gas, Water and Condensate
1% H₂S (9 PPM), Chlorides (120,000 PPM)

LP-017
ISSUED 01/22/97

LINE PIPE**NATURAL GAS**

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

LOCATION Zapata, Texas

PRODUCT 2", 2½", 3", and 4" 1500 PSI Line Pipe
More than 50,000 feet of 2"
More than 120,000 feet of 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

SERVICE CONDITIONS Produced Water, H₂S (5 PPM)
Operating Pressure 970 PSI
Operating Temperature 90°F

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 90° 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 to 120°F; Operating Pressure 1000 PSI; Traces of 20 to 40 Grit Sand.

LP-008
ISSUED 01/22/97
SUPERSEDES 03/15/96

LINE PIPE**NATURAL GAS**

APPLICATION Sour Gas Production Flowlines inserted inside steel

LOCATION Grand Prairie - Alberta, Canada

PRODUCT 3" 2000 PSI Line Pipe

QUANTITY More than 2,000 feet

SERVICE CONDITIONS Natural Gas with 28% H₂S
Operating Pressure 1400 PSI
Operating Temperature 150°F

LP-019
ISSUED 01/22/97

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)

LP-027
ISSUED 01/22/97

LINE PIPE NATURAL GAS PRODUCTION WITH CO₂

APPLICATION Flowline installed in 1991
LOCATION Fowlerton, Texas
PRODUCT 2½" and 3" 1500 PSI Line Pipe
QUANTITY 500 Feet 2½" and 7500 Feet 3"
SERVICE
CONDITIONS Operating Pressure 650 PSI
 Operating Temperature 100 to 110°F

LP-026
ISSUED 01/22/97

LINE PIPE PRODUCED GAS AND CO₂

APPLICATION Flowline Installed in 1992
LOCATION Edinburg, Texas
PRODUCT 2½" 2000 PSI Line Pipe
QUANTITY 4,650 Feet
SERVICE
CONDITIONS Operating Pressure 850 PSI
 Operating Temperature 120°F

LP-024
ISSUED 01/22/97

LINE PIPE PRODUCED GAS AND H₂S

APPLICATION Buried Flowing installed in 1988
LOCATION Staffhorst, Germany
PRODUCT 4" 1500 PSI Line Pipe, Threaded and Coupled
QUANTITY 1500 Meters
SERVICE
CONDITIONS Operating Pressure 40 Bar (580 PSI)

LP-025
ISSUED 01/22/97

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