



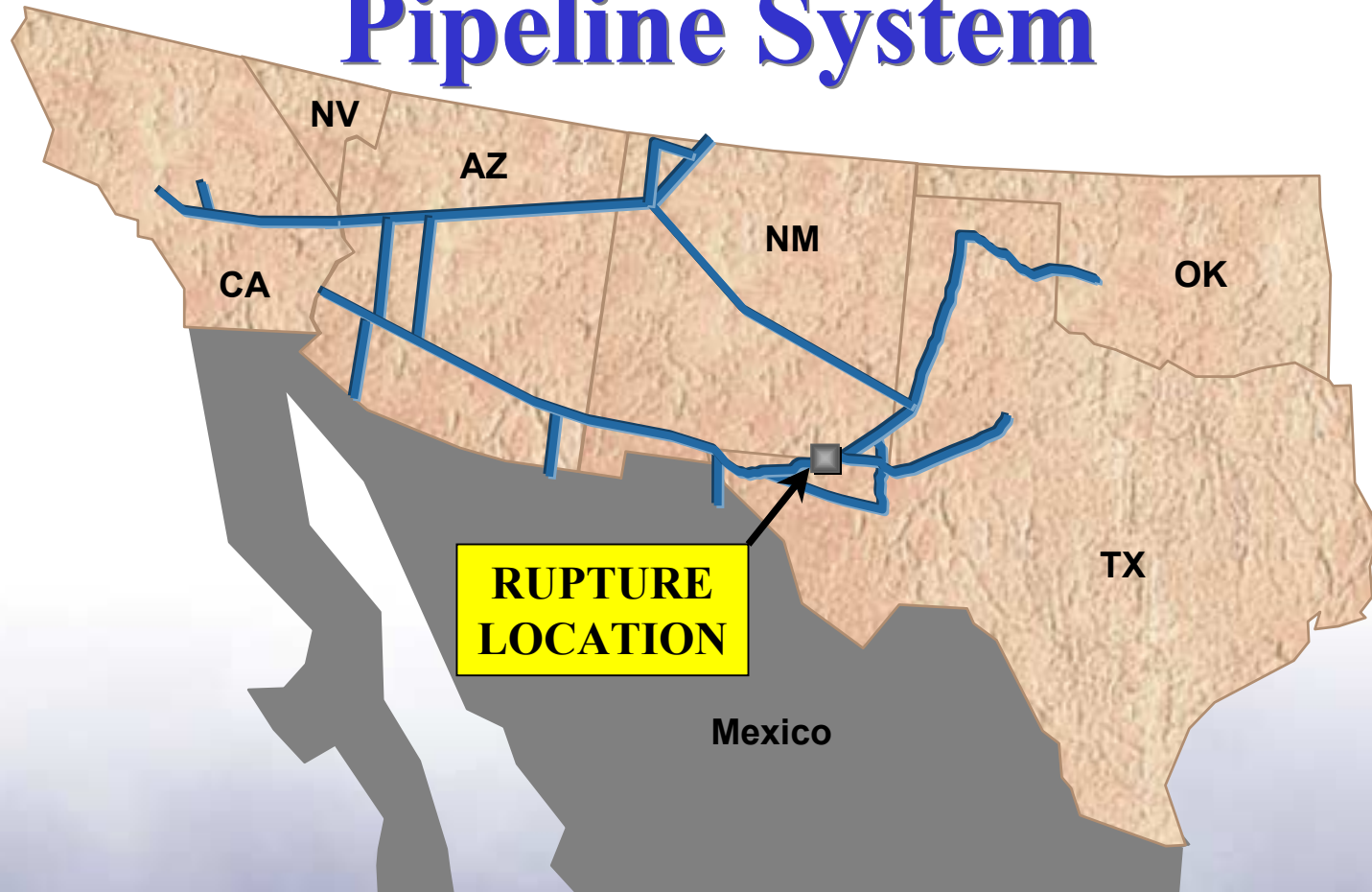
**National Transportation Safety Board**

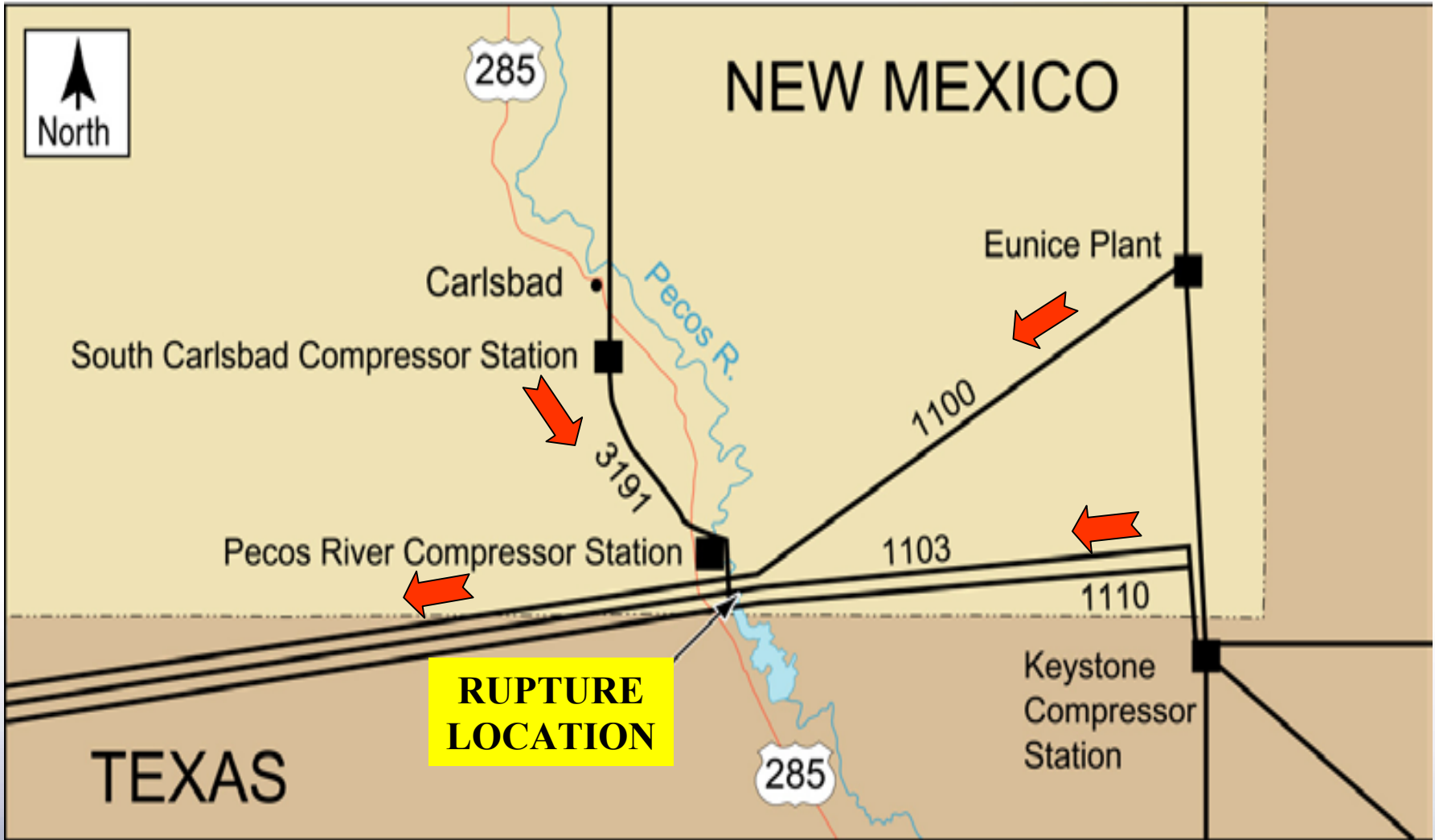
**Carlsbad, New Mexico**  
**August 19, 2000**

**Pipeline Rupture and Fire**  
**El Paso Natural Gas Company:**  
**Gas Transmission Line No. 1103**



# El Paso Natural Gas Company Pipeline System









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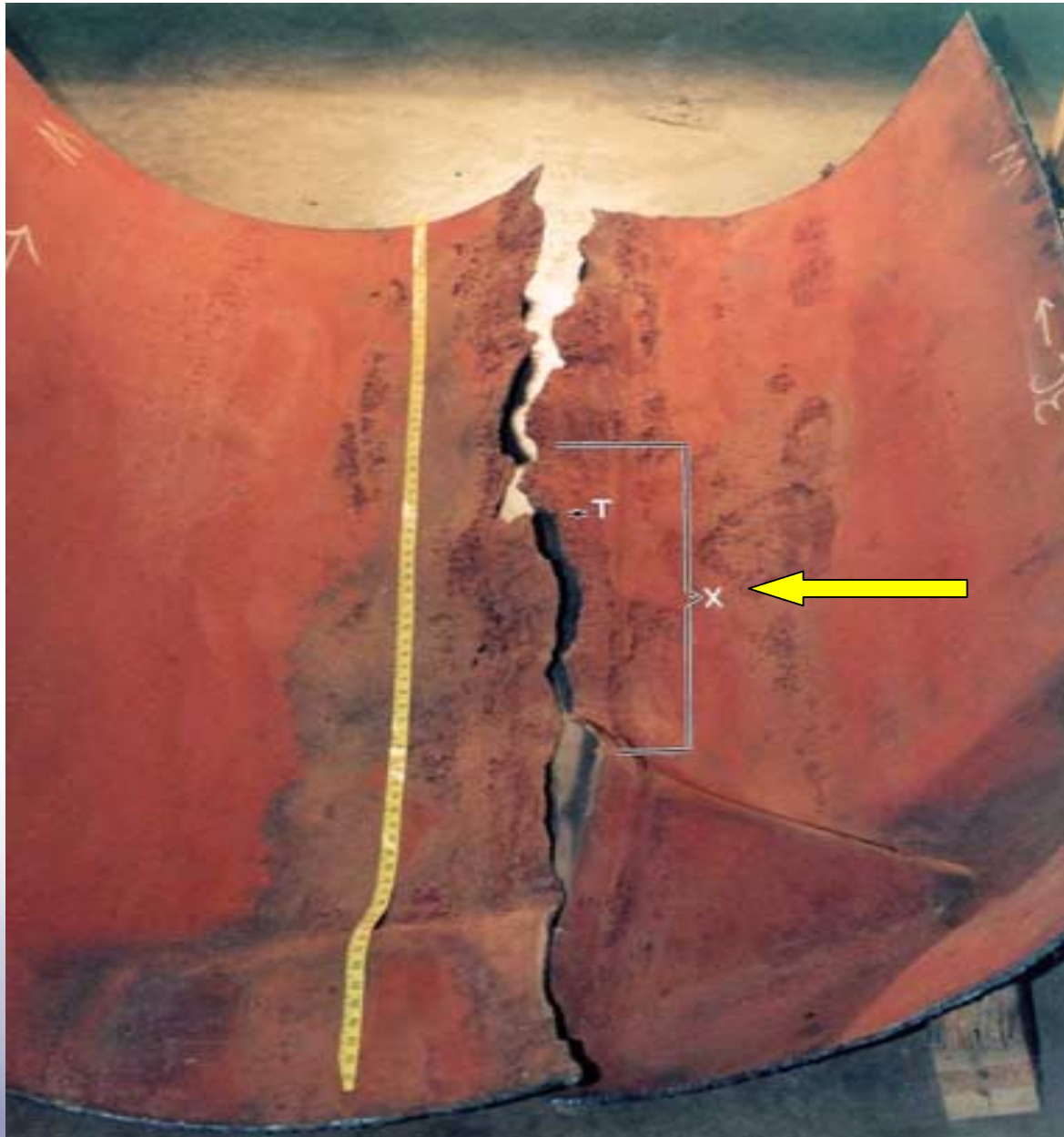


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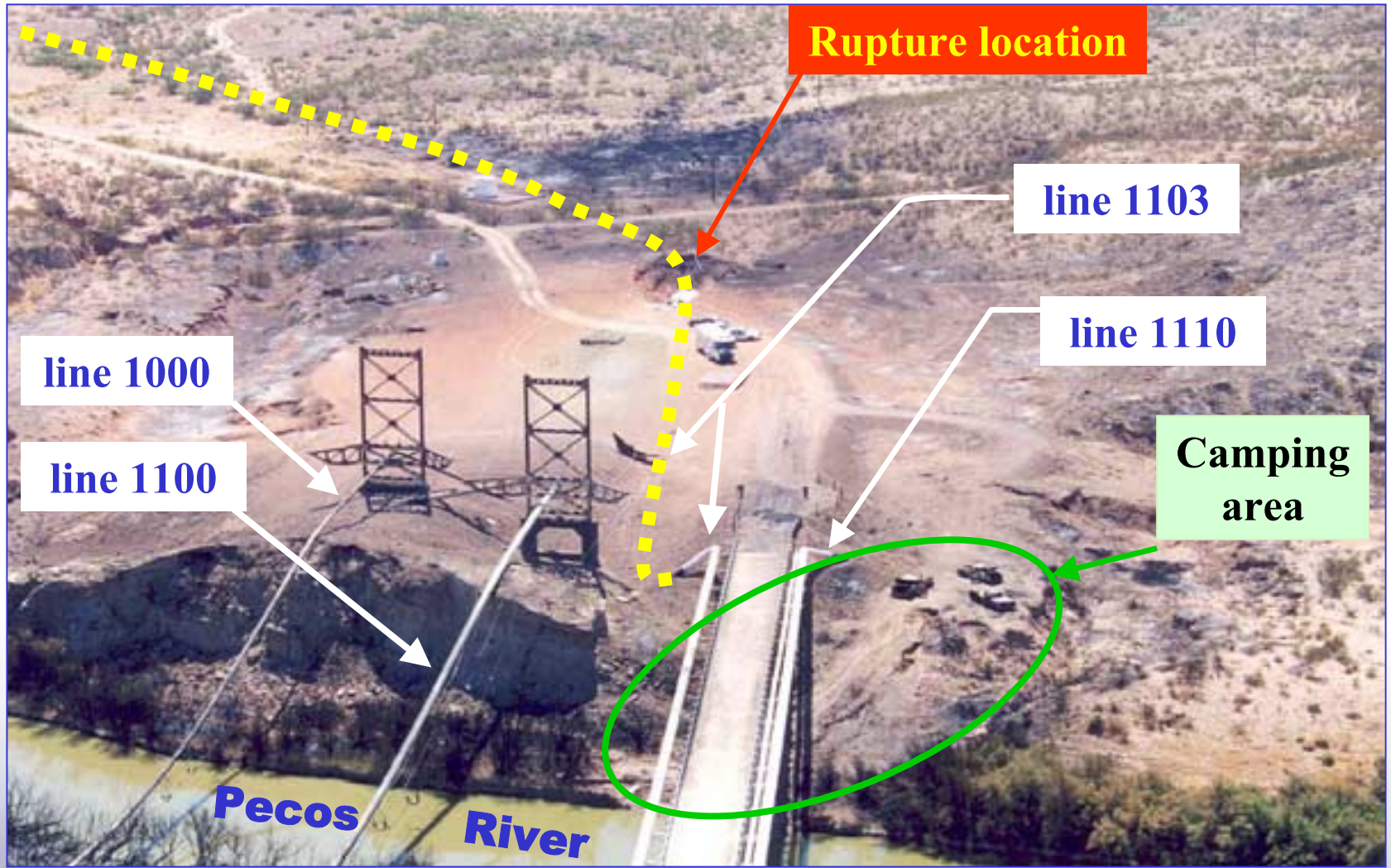


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**Rupture location**

**line 1103**

**line 1110**

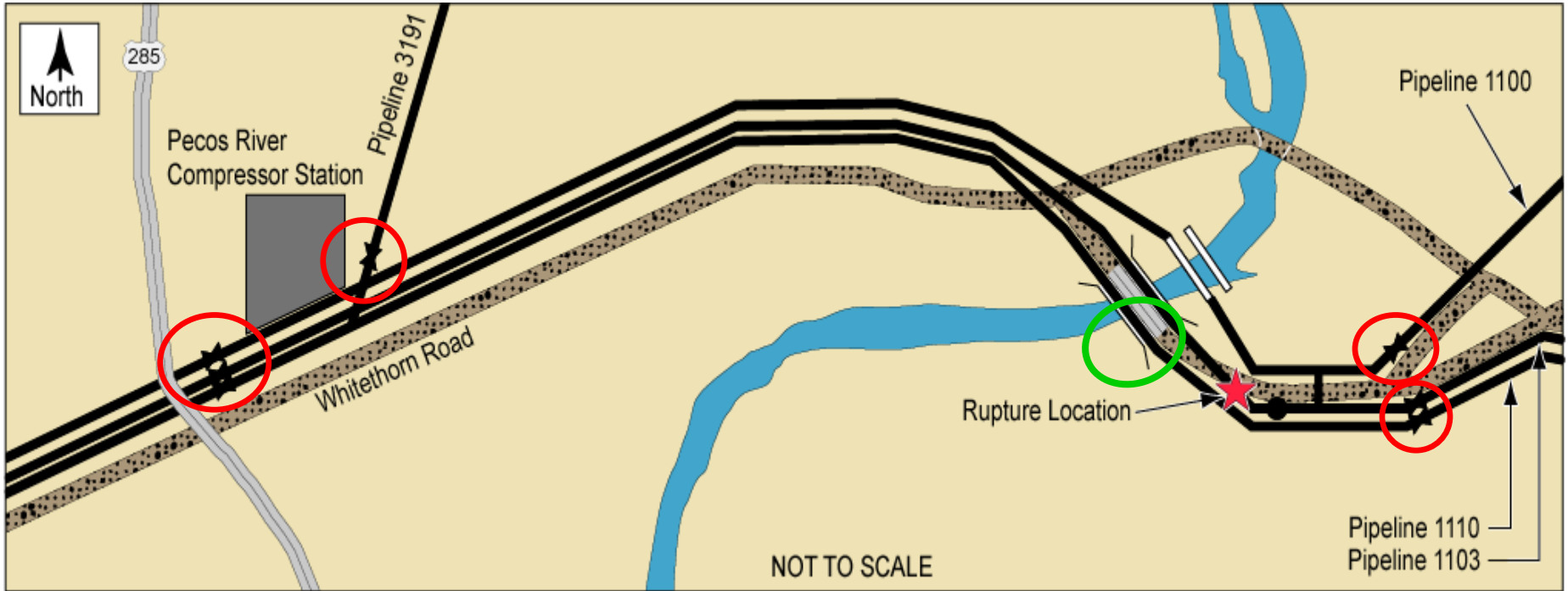
**Camping area**

**line 1000**

**line 1100**

**Pecos River**





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# Parties to the Investigation

- **Office of Pipeline Safety (OPS)/Research and Special Programs Administration (RSPA)**
- **El Paso Natural Gas Company**



# Investigation Team

- **Rick Flint** Report Writer / Investigator-in-Charge
- **Cliff Zimmerman** Investigator-in-Charge
- **Ravi Chhatre** Corrosion
- **Frank Zakar** Materials Laboratory
- **Chuck Koval** Operations and Training
- **Eric Sager** Human Performance
- **Jim Gildea** Survival Factors
- **Joe Kris** Survival Factors
- **Robert Moore** Editor



# Safety Issues

- **Design and construction of the pipeline**
- **El Paso Natural Gas Company's program for internal corrosion control**
- **Federal Safety regulations**
- **Federal oversight of El Paso Natural Gas Company**





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# **Safety Issue #1**

## **Design and construction of the pipeline**





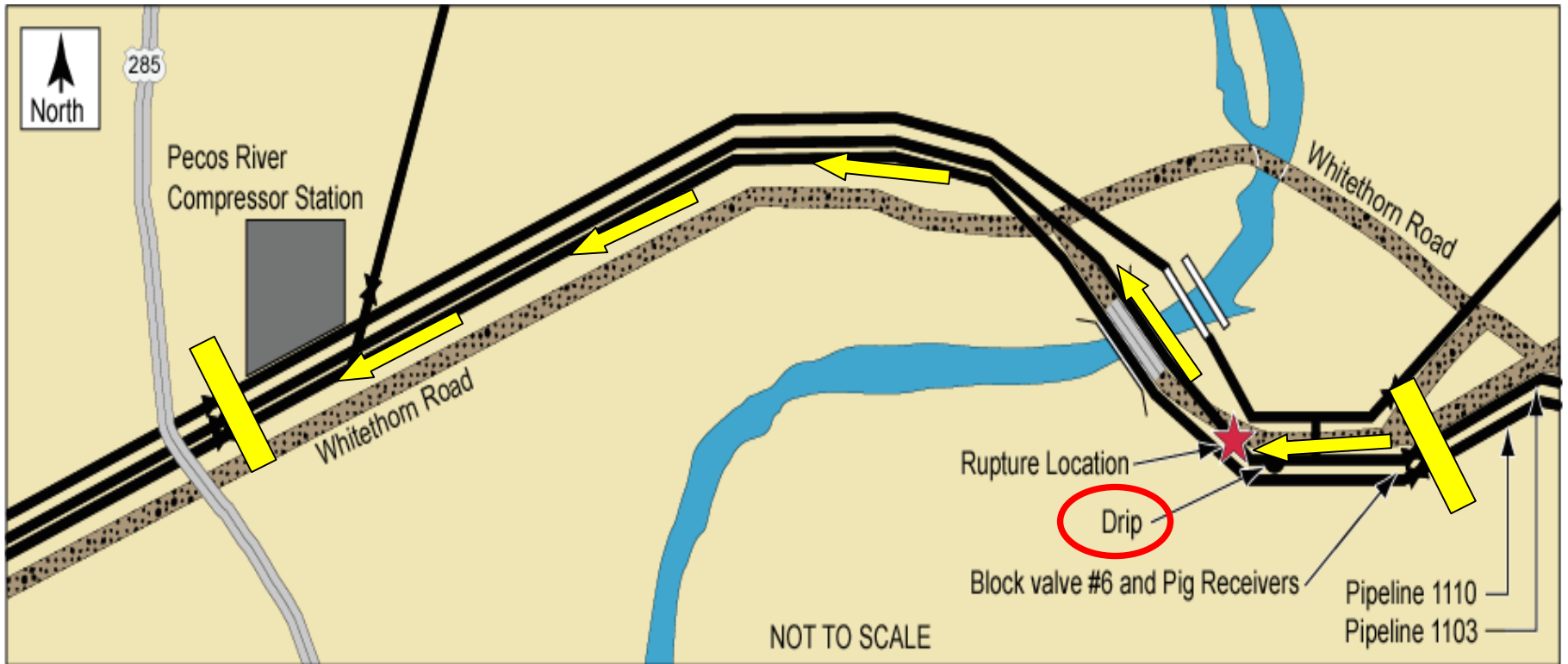


**Mandrel pigs**



**Solid pigs**

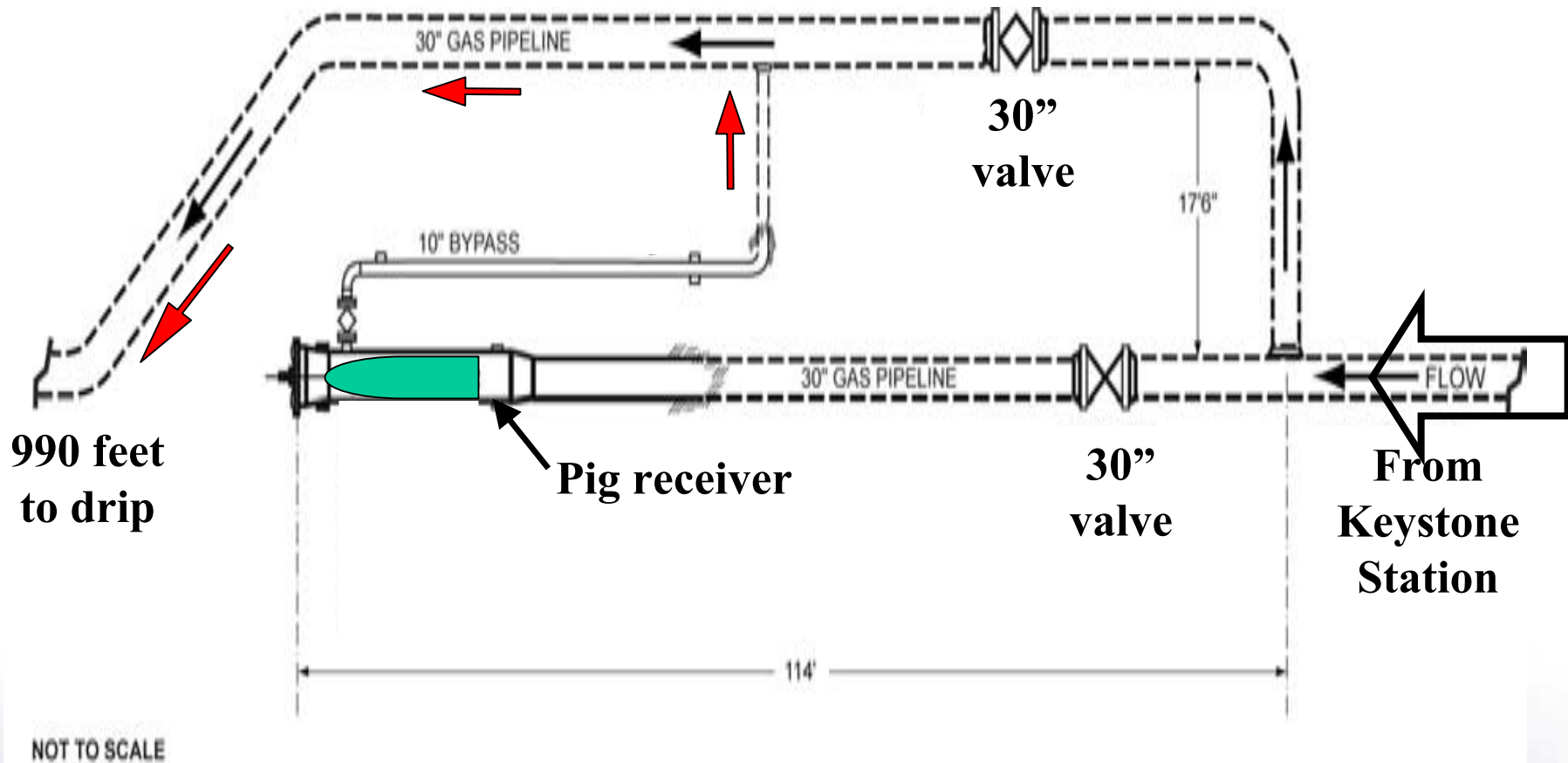




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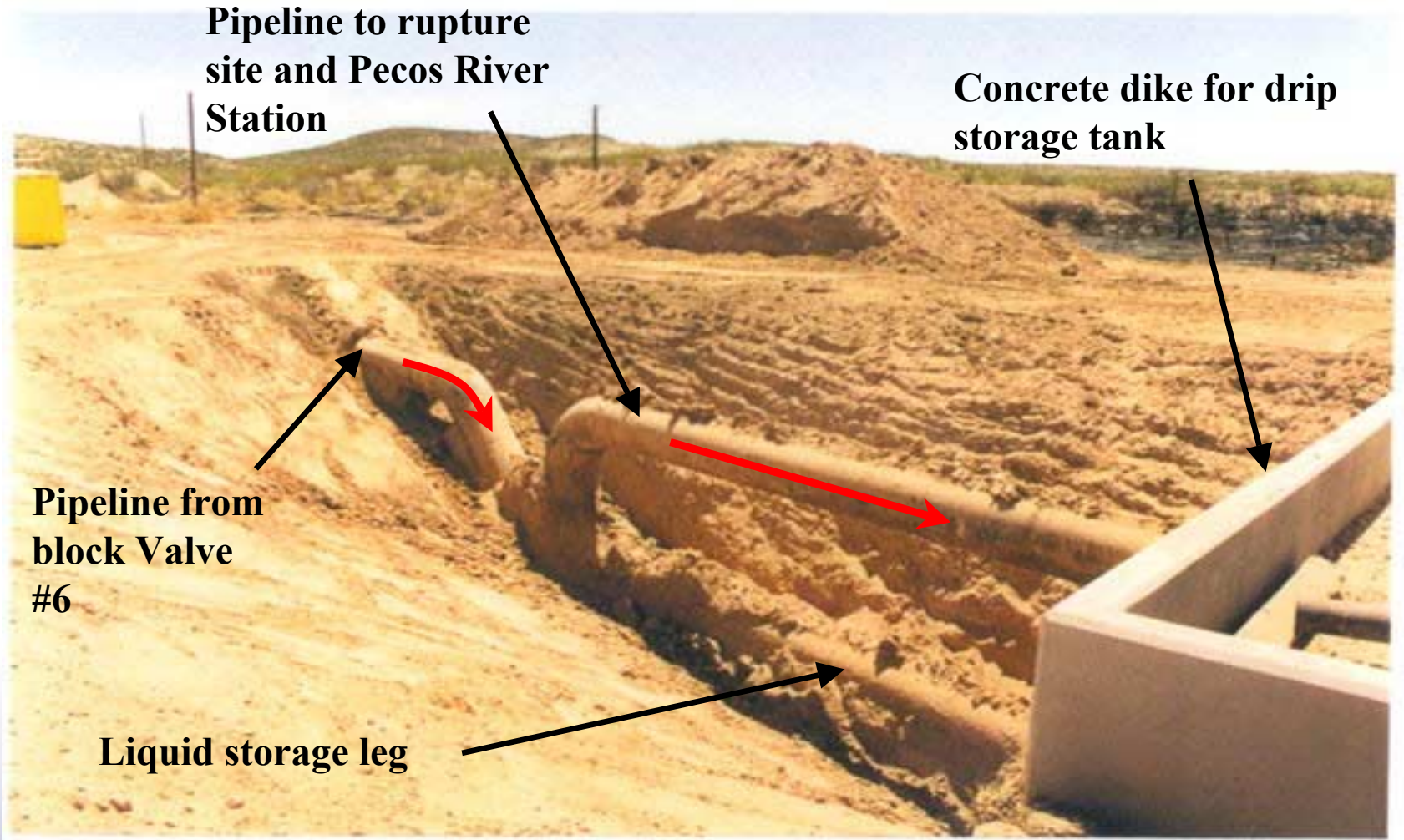


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**Plan View of Block Valve #6**





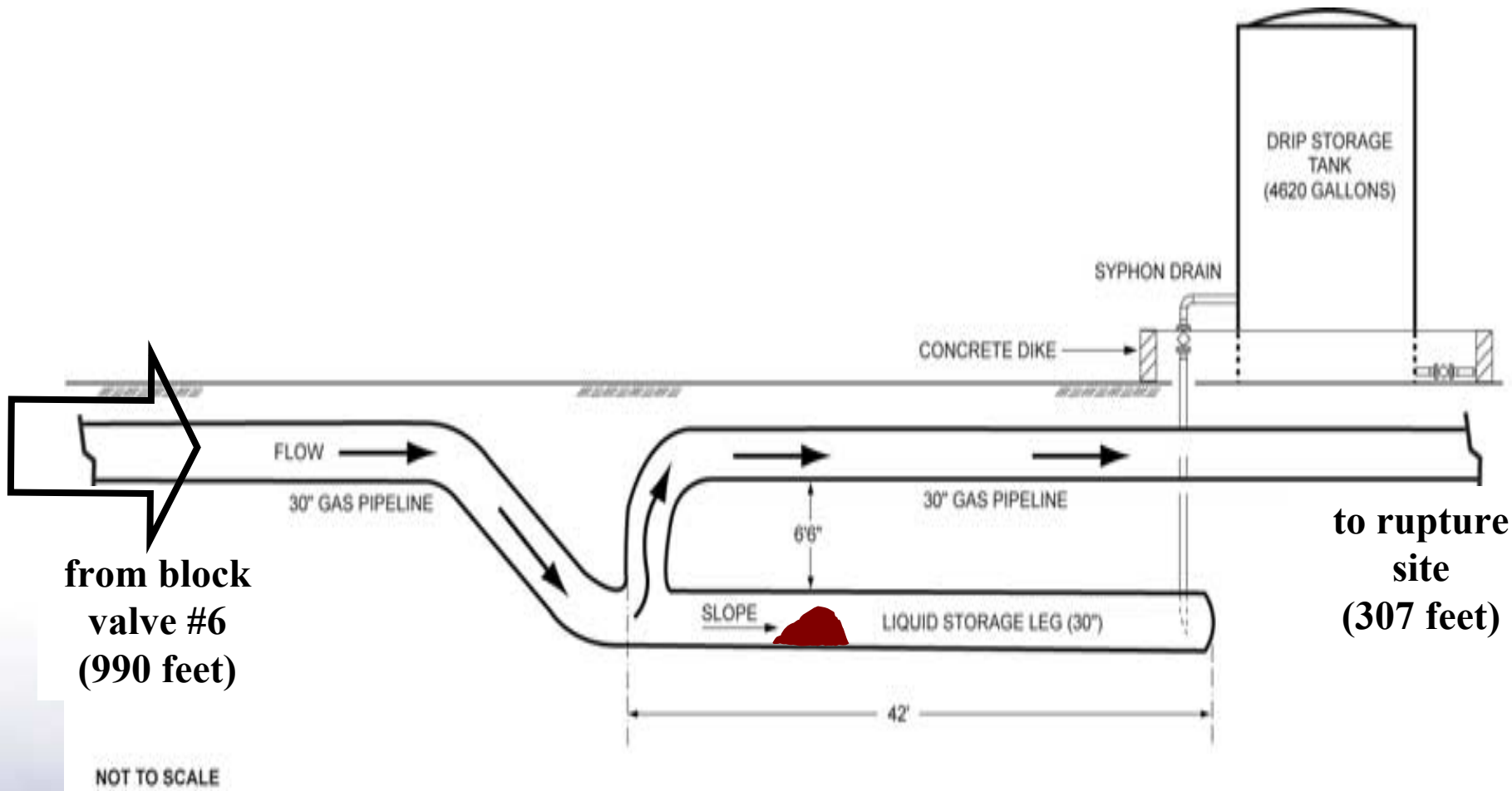
**Pipeline to rupture site and Pecos River Station**

**Concrete dike for drip storage tank**

**Pipeline from block Valve #6**

**Liquid storage leg**

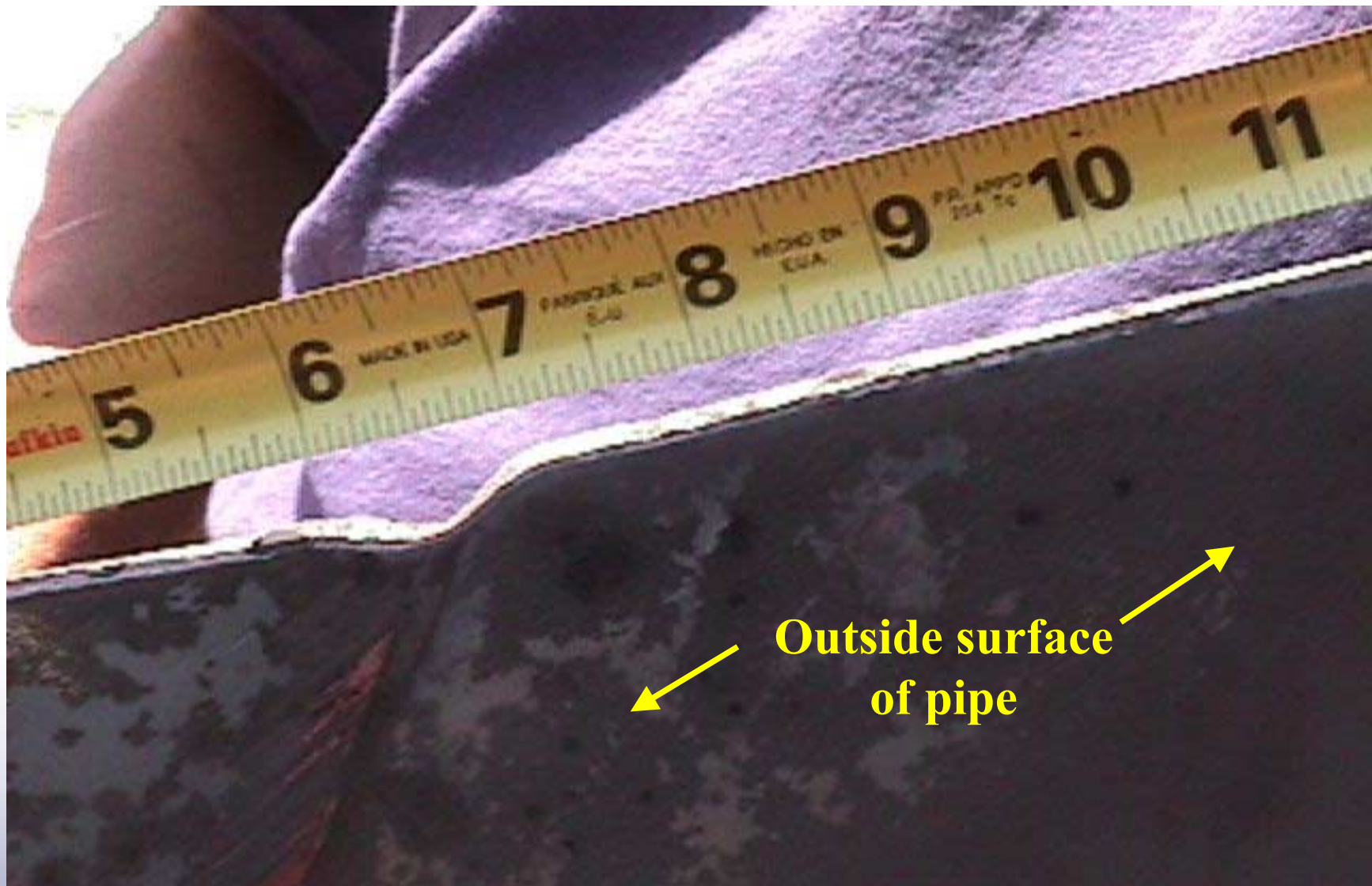


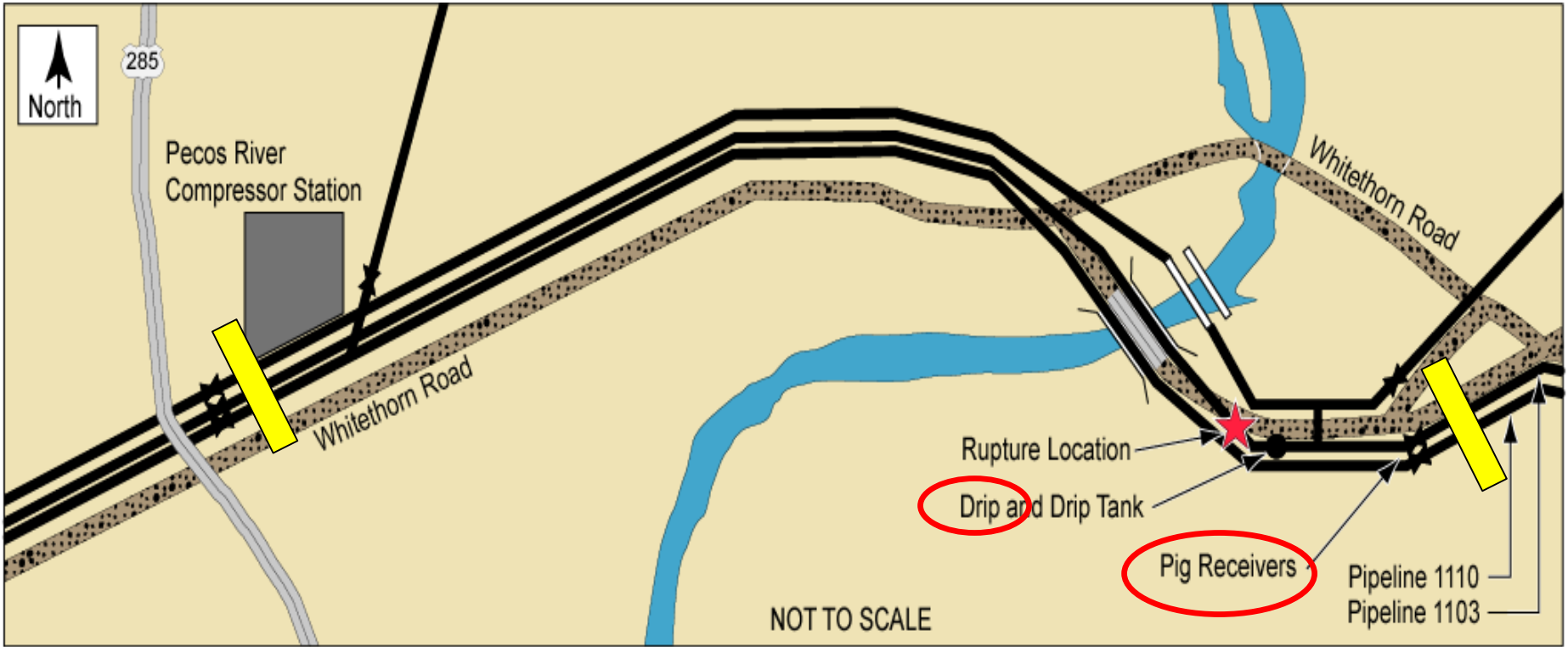


from block valve #6 (990 feet)

to rupture site (307 feet)







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# **Safety Issue # 2**

**El Paso Natural Gas  
Company's program for  
internal corrosion control**



# **Line 1103 Failure**

**Severe internal corrosion**



# Photograph Showing Pitting Damage



Pitting corrosion  
(isolated pits)

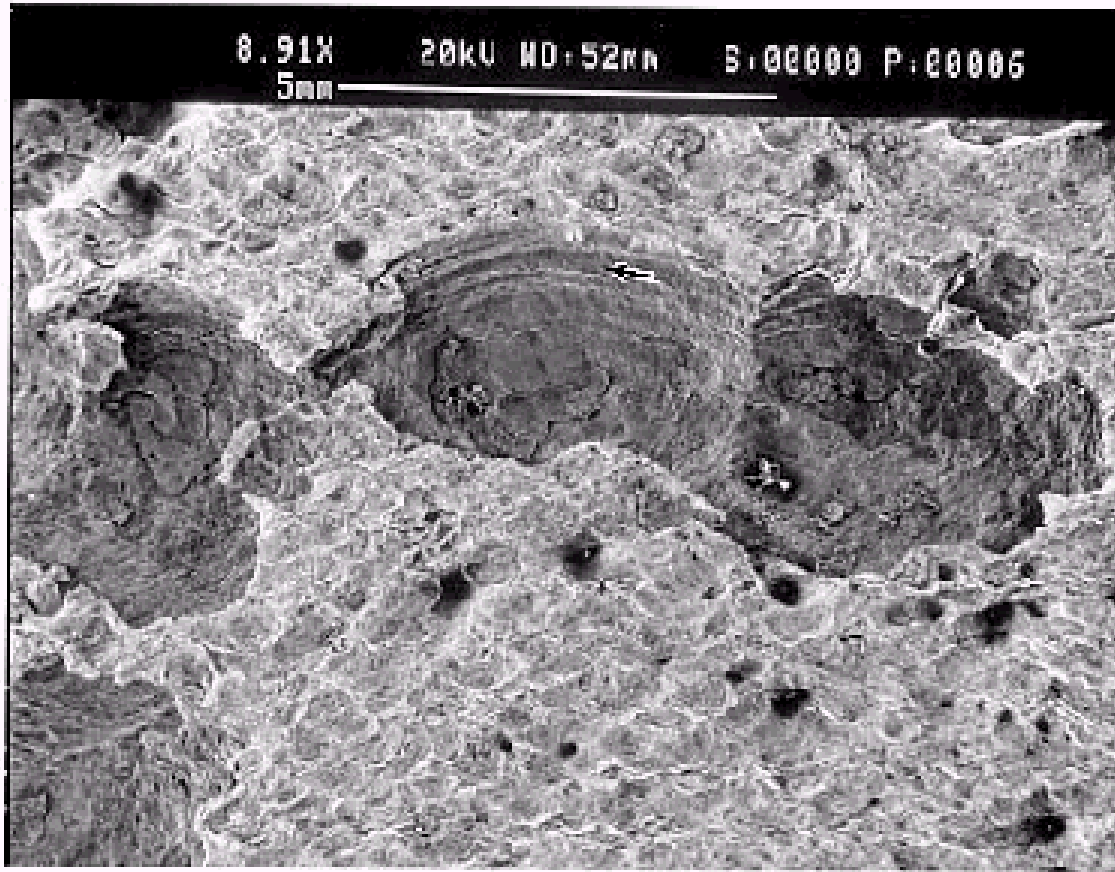
Patches of  
interconnected pits

Area of severe  
corrosion damage

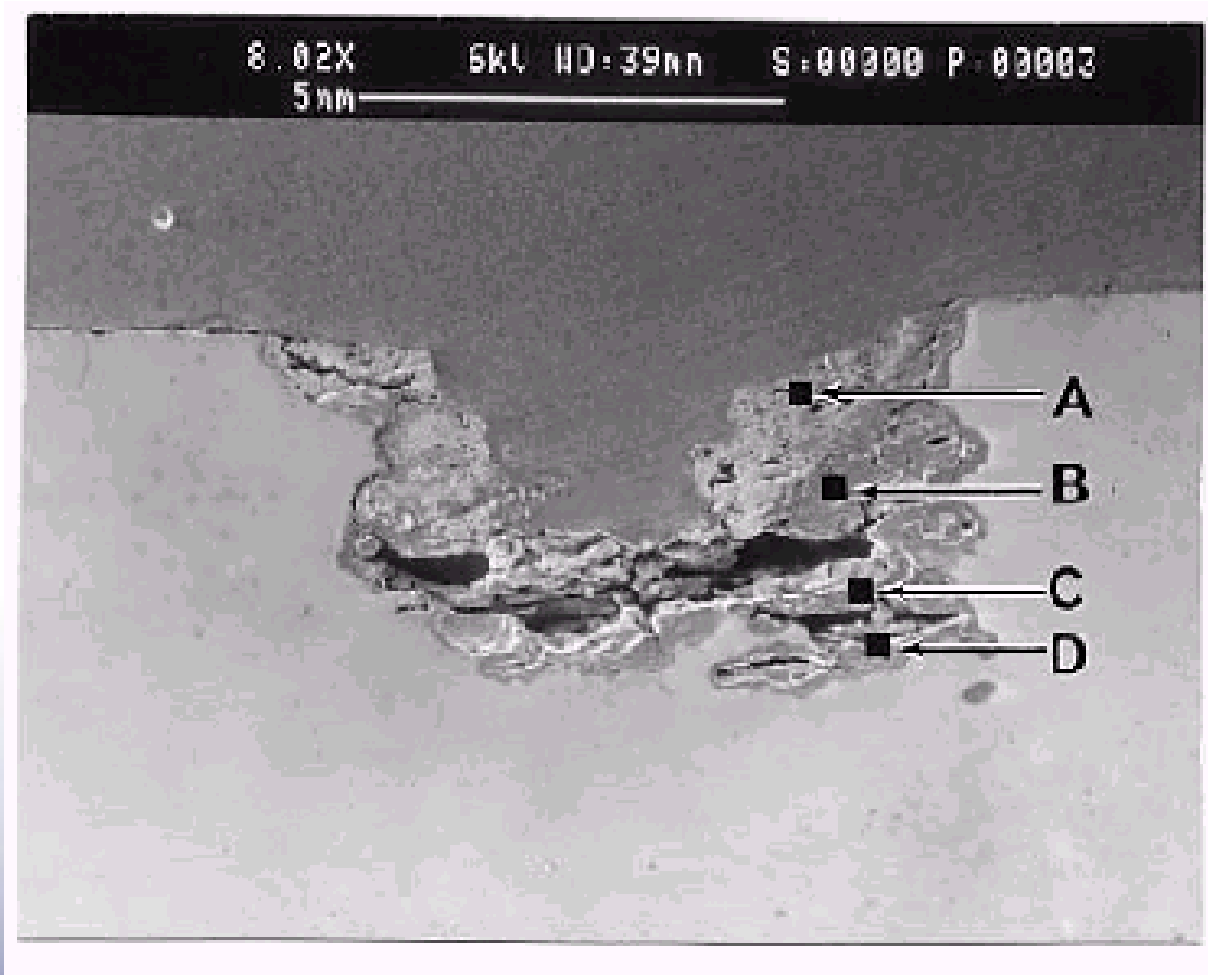
Fracture (6 o'clock)



# Scanning Electron Microscope Photograph



# Scanning Electron Microscope Photograph



- **Electrolyte ( water )**
- **Carbon Dioxide ( CO<sub>2</sub> )**
- **Hydrogen Sulfide ( H<sub>2</sub>S )**
- **Oxygen (O<sub>2</sub>)**
- **Chloride ( Cl<sup>-</sup> )**
- **Microorganisms**



# Gas Velocity

- **Low gas velocity allows for liquids to separate from gas and collect in the pipeline**
- **Stagnant liquid pools could exist and facilitate corrosion**





# **El Paso's Internal Corrosion Control Program**



# **Controlling and Monitoring of the Quality of Gas In the Pipelines**

- **No reference of contaminants in procedures**
- **Some locations had gas quality monitoring**



# Running cleaning pigs to remove liquids



# Blowing down drips



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# Revised Program

- **El Paso had revised their internal corrosion control program**
- **The new corrosion control manual was issued less than six weeks before the Carlsbad accident, and El Paso had not fully implemented it**



# INDUSTRY STANDARDS

- **The American Society of Mechanical Engineers Code for Gas Piping (B31.8)**
- **The American Gas Association Guide for Gas Transmission and Distribution Piping Systems**
- **NACE International's (NACE) recommended practice RP0175-75 "Control of Internal Corrosion in Steel Pipelines and Piping Systems"**





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# **Safety Issue #3**

## **Federal Safety Regulations**





# Federal Safety Regulations

The regulations for internal corrosion control for gas pipelines in effect at the time of the accident are in 49 CFR Part 192, “Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards,” as follows:



## **192.475 Internal Corrosion Control:**

- Corrosive gas may not be transported by pipeline, unless the corrosive effect of the gas on the pipeline has been investigated and steps have been taken to minimize internal corrosion.
- Whenever any pipe is removed from a pipeline, the internal surface must be inspected for evidence of corrosion.



If internal corrosion is found:

- The adjacent pipe must be investigated to determine the extent of internal corrosion,
- Replacement must be made
- Steps must be taken to minimize the internal corrosion.



## **192.477 Internal Corrosion Control:**

- Monitoring: if corrosive gas is being transported, coupons or other suitable means must be used to determine the effectiveness of the steps taken to minimize internal corrosion.
- Each coupon or other means of monitoring internal corrosion must be checked two times each calendar year, but with intervals not exceeding 7 1/2 months.



These regulations do not specifically address:

- The importance of minimizing liquids and liquid accumulation in the pipeline, and removing liquids from the pipeline
- Maintaining drips
- Microbiologically influenced corrosion
- The way that water and contaminants in the pipeline can combine to contribute to the corrosion process
- The role of gas velocity in internal corrosion control





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# **Safety Issue #4**

## **Federal oversight of EPNG**



# OPS Inspections of EPNG

- 18 inspections from June 1990 to August 1998
- 8 inspections from July 1999 to September 2000 as a participant in the Office of Pipeline Safety's (OPS) "System Integrity Inspection Pilot Program"





# OPS Inspections of EPNG (cont'd)

- Pre-Carlsbad Accident: inspections in the 10 years prior to the accident did not result in any enforcement actions related to internal corrosion control program
- Post-Carlsbad Accident: OPS found serious deficiencies in El Paso Natural Gas Company's internal corrosion control program





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