



**National  
Transportation  
Safety Board**

# **Organizational Issues and System Failures in Transportation**

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Stanford CEE Special Lecture  
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# INTRODUCTION TO NTSB



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# **NTSB is an Independent Federal Agency**

**Not part of US Department of Transportation**

**Our mission: Investigate transportation accidents, determine probable cause, issue safety recommendations**

**We do not have regulatory authority**





# The Board



**Earl Weener**



**Bella Dinh-Zarr**  
Vice Chairman



**Chris Hart**  
Chairman



**Robert Sumwalt**



# The Investigators



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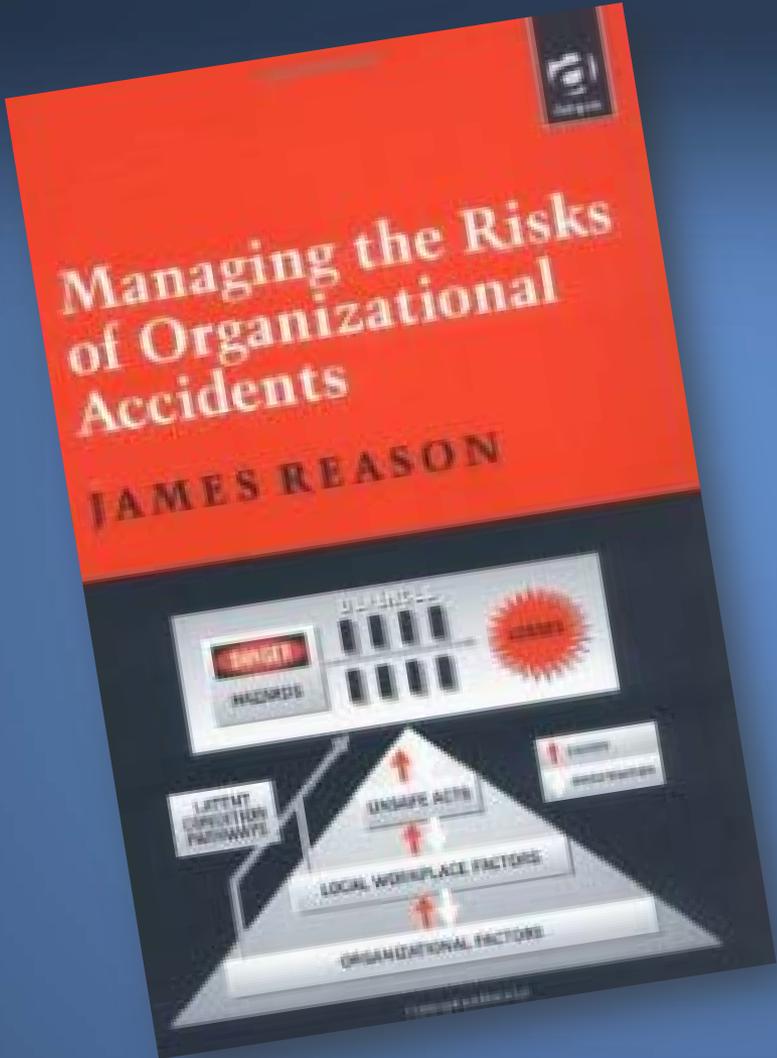
# ORGANIZATIONAL ACCIDENTS IN TRANSPORTATION



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The NTSB has recognized organizational factors as a contributing factor in several accidents.





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# Two types of accidents

- Individual accidents – those resulting from the actions/inactions of individual people.
  - i.e., A person, following properly established procedures, loses balance and falls of ladder
- Organizational accidents – those resulting largely from actions/inactions of companies/organizations.
  - i.e., A train runs into back of another train, claiming multiple lives
    - Employees develop work-arounds instead of following procedures
    - Organization does not learn from prior events and precursors
    - Senior management is focused on finances and customer service
    - Organization uses wrong metrics to gauge safety
    - Regulatory oversight is not sufficient



# Characteristics of Organizational Accidents

- Multiple contributing causes
- Involve people at numerous levels within a system
- Pervasive lack of proactive measures to ensure a culture of safety
- Catastrophic events, often involving substantial loss of life, and/or significant damage to property and/or property
- Require complex organizational changes to avoid them in the future.



# Latent organizational failures

- Lack of top-level management safety commitment or focus
- Conflicts between production and safety goals
- Poor planning, communications, monitoring, control or supervision
- Organizational deficiencies leading to blurred safety and administrative responsibilities
- Deficiencies in training
- Poor maintenance management or control
- Monitoring failures by regulatory or safety agencies

# Failures in multiple layers

Accident



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# CASE STUDY # 1



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# Collision between two subway trains in Washington, DC

- “ ... the accident did not result from the actions of an individual but from the ‘accumulation of latent conditions within the maintenance, managerial and organizational spheres’ making it an example of a ‘quintessential organizational accident.’”



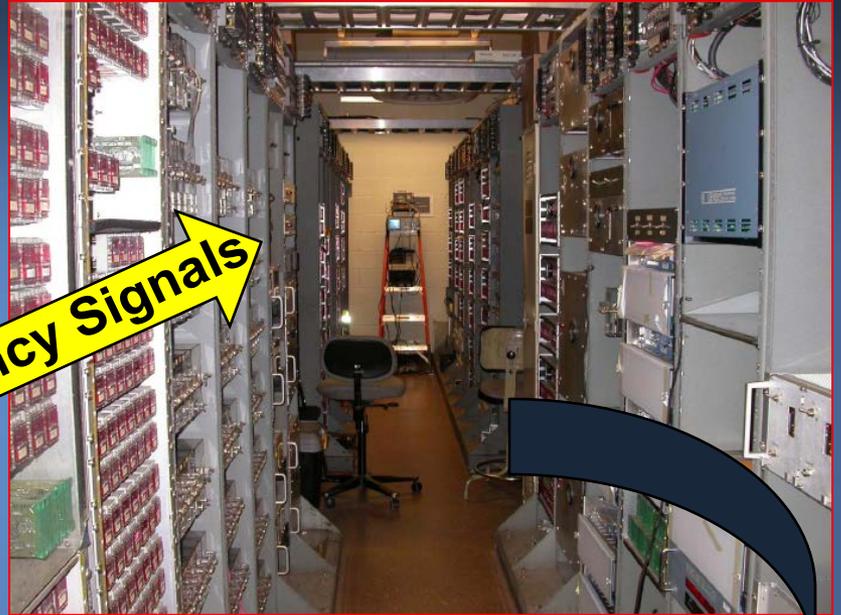
# Washington DC Subway (WMATA)



# Technical failure



False Vacancy Signals



# The environment at WMATA

- Punitive culture – employees feared retribution from management and co-workers for reporting safety-related problems
- FTA audit found WMATA managers were reactive rather than proactive in assessing and addressing the agency's most serious safety hazards
- WMATA did not learn from prior events
  - A loss of shunt detection procedure – one that could have detected the track circuit problem – was never institutionalized
- Widespread procedural non-compliance



# The environment at WMATA

“the mentality now is move trains”

**Post-accident statements made by the supervisor of the construction, installation, and testing crew were indicative of an emphasis on maintaining operations over safety.**



# NTSB finding

“The low priority that WMATA Metrorail managers placed on addressing malfunctions in the train control system before the accident likely influenced the inadequate response to such malfunctions by automatic train control technicians, operations control center controllers, and train operators.”



# Where was safety?

## WMATA mission statement:

- “Metro provides the nation’s best transit service to our customers and improves the quality of life in the Washington metropolitan area.”

## WMATA Board of Directors By Laws

- “...determines agency policy and provides oversight for the funding, operation and expansion of transit service ...”



# Board of Directors

- Viewed themselves solely as a “policy board”
- Relied on the General Manager to bring safety-related information to them
- Used the wrong metrics to gauge rail safety
  - Rail passenger injuries, escalator injuries, derailments, smoke and fire event, crime
- Did not insist in following-up on prior audit findings, despite a requirement to do so
- Placed much of the blame for causing and much of the responsibility for preventing accidents on frontline personnel



# Conflicting goals

- Customer Services, Operations, and Safety Committee



# NTSB finding

“The WMATA Board of Directors did not exercise oversight responsibility for the system safety of the WMATA system.”



# NTSB finding

“Before the accident, the WMATA Board of Directors did not seek adequate information about, nor did it demonstrate adequate oversight to address, the number of open corrective action plans from previous Tri-State Oversight Committee and Federal Transit Administration safety audits of WMATA.”



# Probable Cause



- Failure of the track circuit modules that caused the automatic train control system to lose detection of the first train
- WMATA's failure to ensure that an enhanced track circuit verification test was institutionalized and used system-wide after a 2005 precursor event (near-collisions), which would have identified the faulty track circuit before this accident

# Contributing to the Accident

- WMATA's lack of a safety culture
- WMATA's failure to effectively maintain and monitor performance of the ATC system
- GRS/Alstom failure to provide a maintenance plan to detect spurious signals that could cause a malfunction
- Ineffective oversight by WMATA Board of Directors
- Ineffective oversight by State Safety Oversight agency and its lack of safety oversight authority
- FTA's lack of statutory authority to provide Federal safety oversight



# Failures in multiple layers

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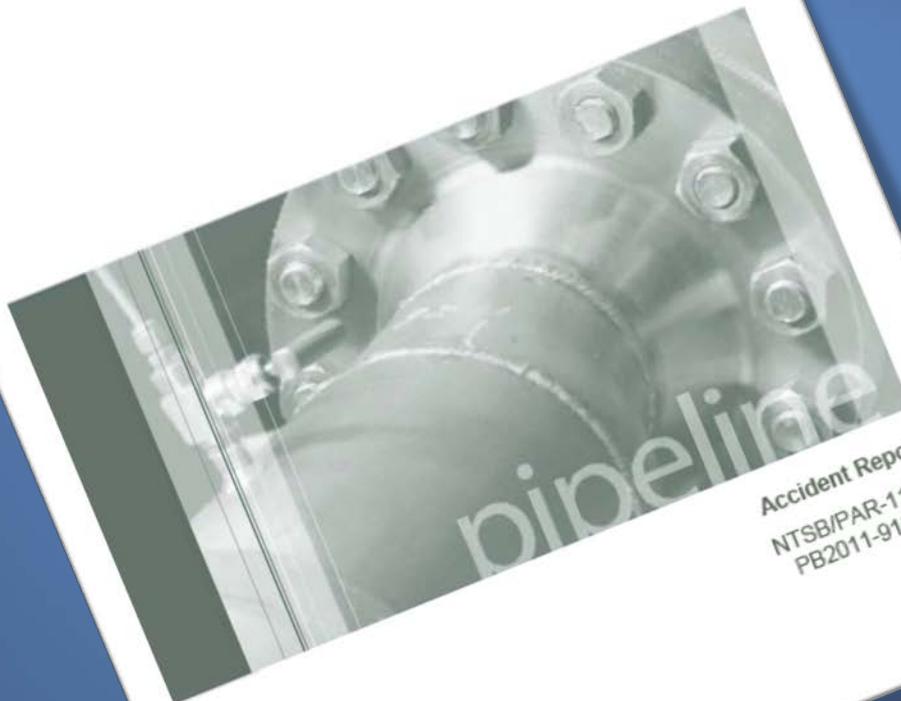
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# CASE STUDY # 2



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Pacific Gas and Electric Company  
Natural Gas Transmission Pipeline Rupture and Fire  
San Bruno, California  
September 9, 2010



Accident Report  
NTSB/PAR-11/01  
PB2011-916501

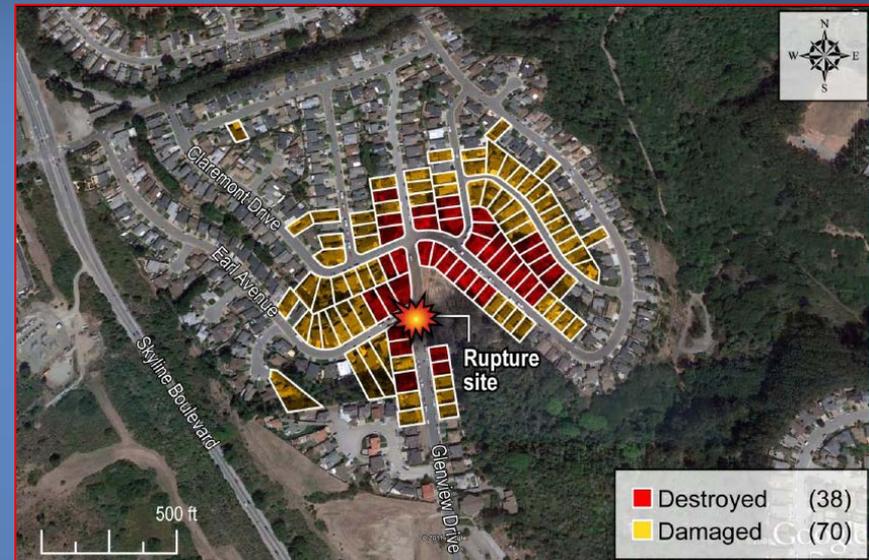


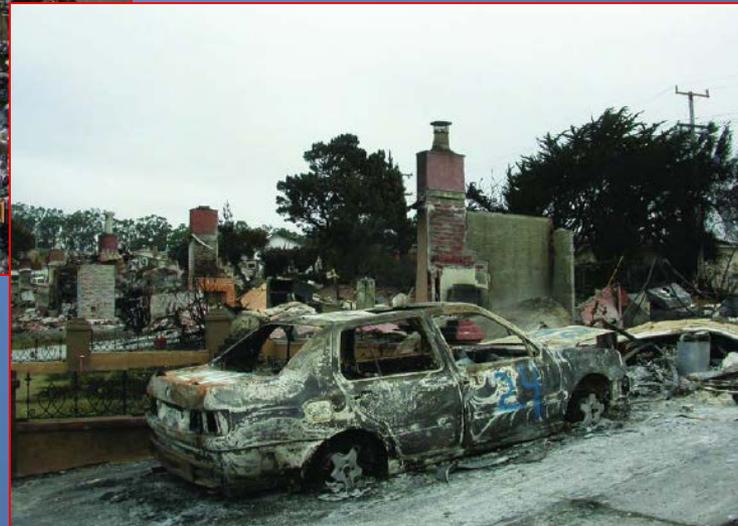
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- 8 fatalities
- 10 serious injuries
- 48 minor injuries
  
- 108 houses affected
  - 38 homes destroyed
  - 17 homes severe-to-moderate damage
  - 53 minor damage





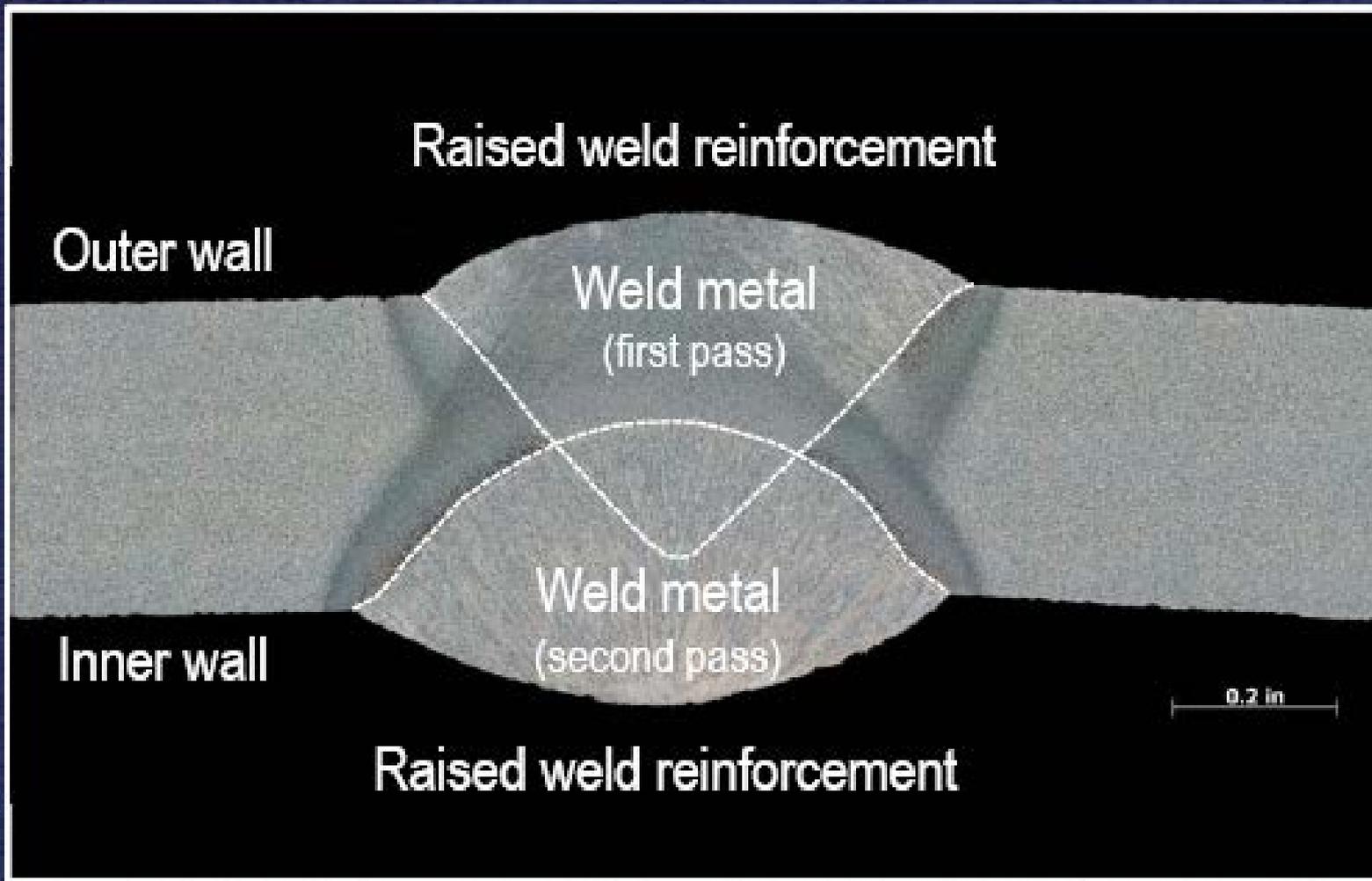


- “The character and quality of PG&E’s operations, as revealed by this investigation, indicate that the San Bruno pipeline rupture was an organizational accident.”

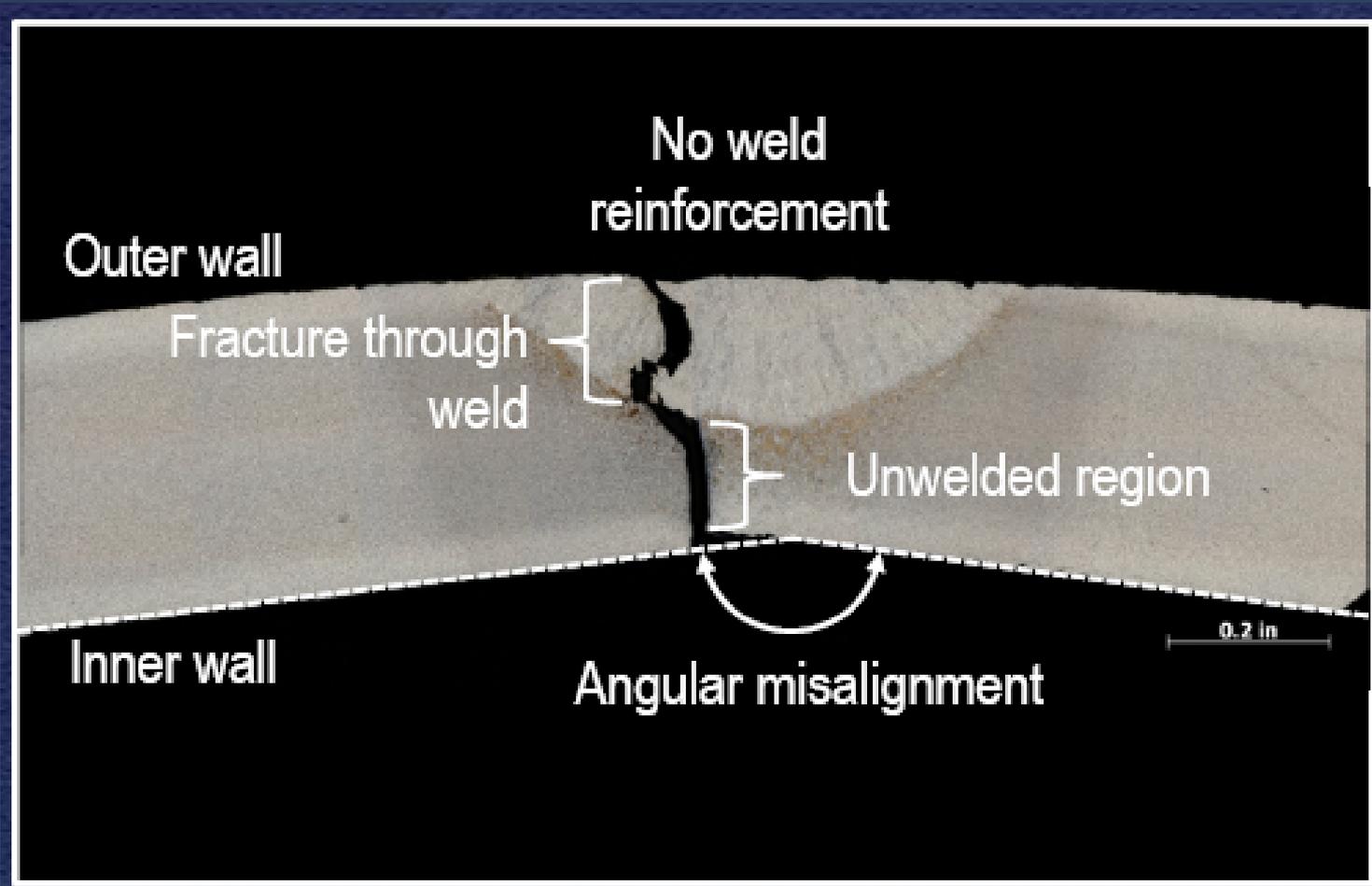


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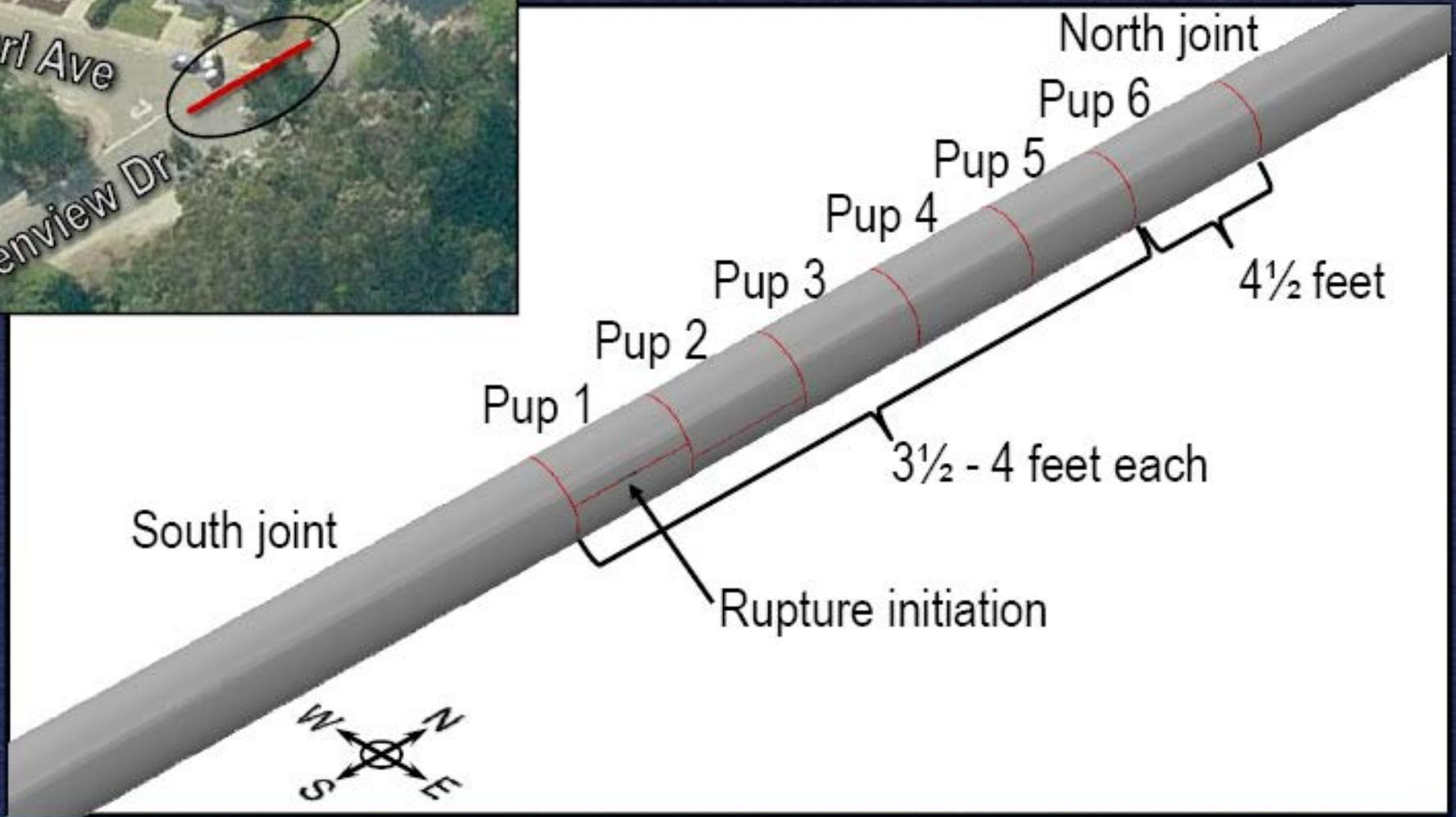
# Typical DSAW Seam Weld



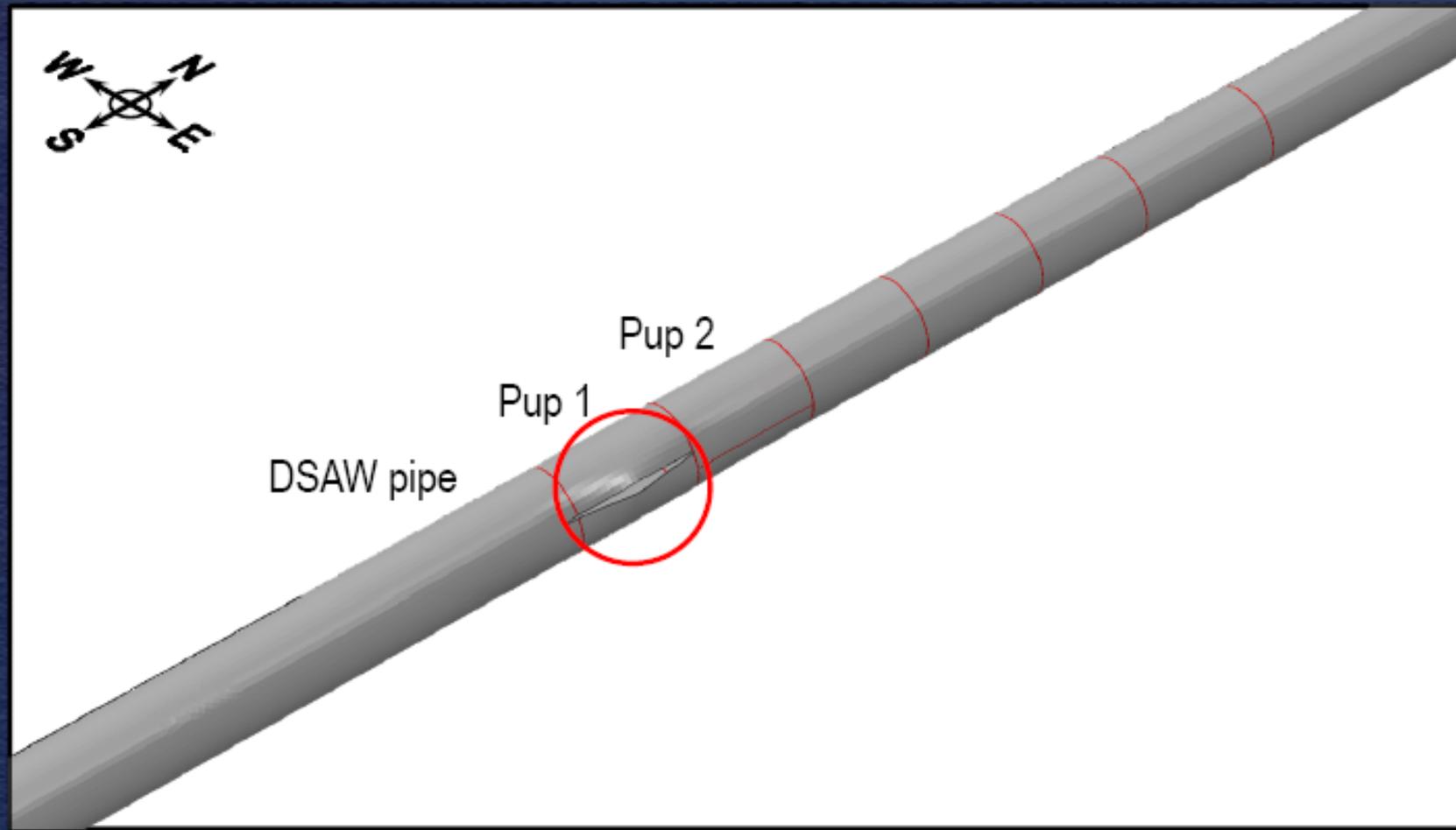
# Incomplete Pup 1 Seam Weld



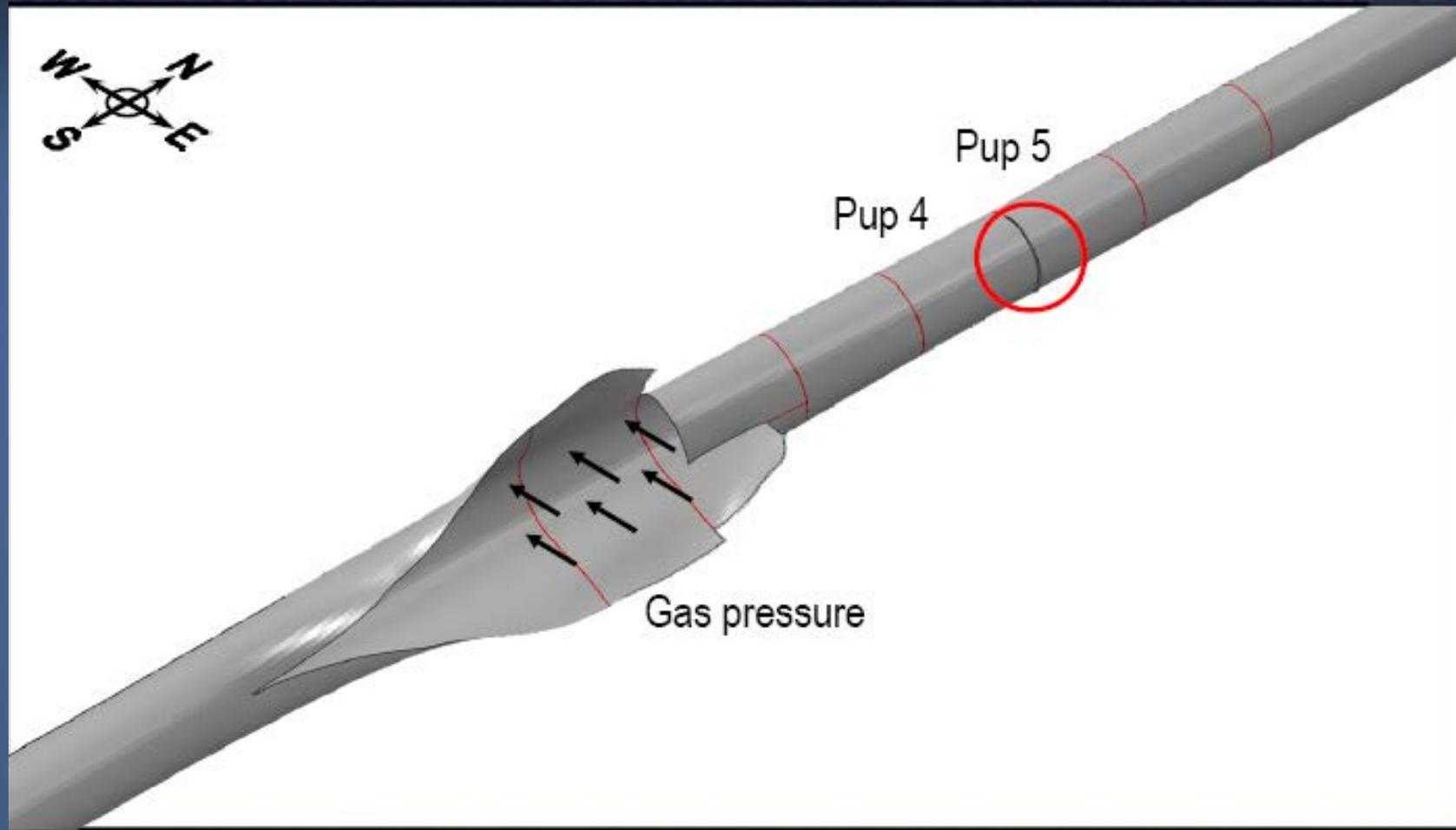
# Construction of the Pipe



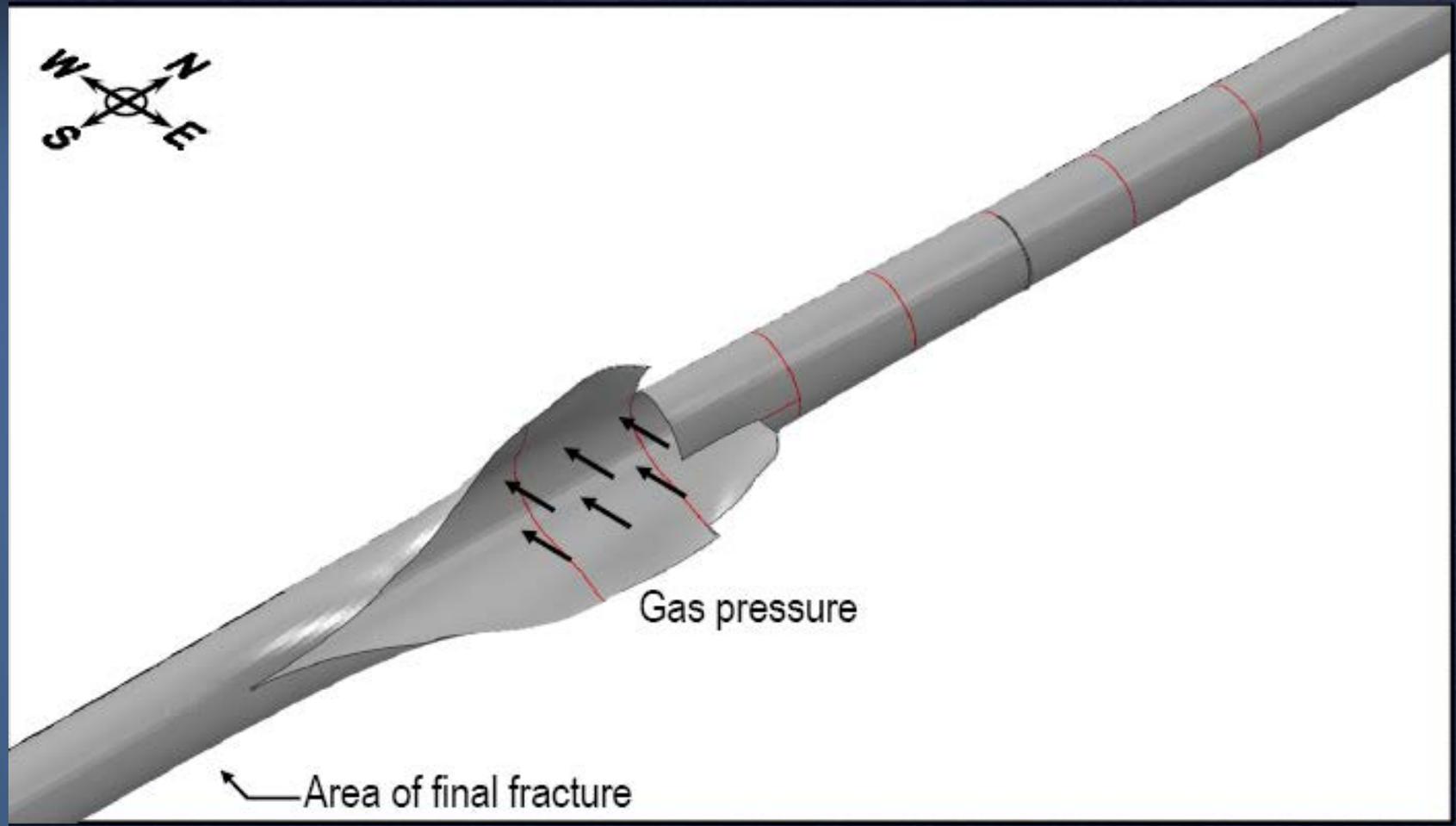
# Rupture Sequence

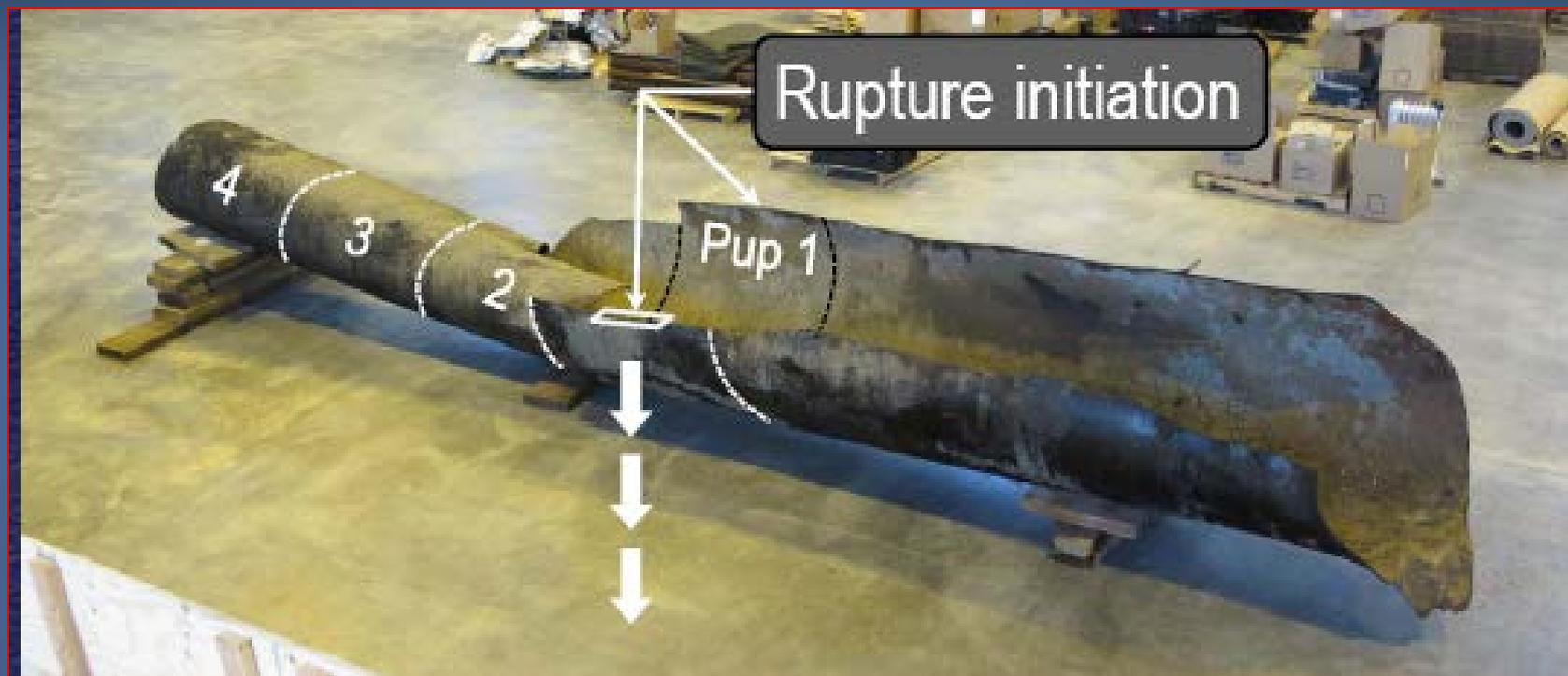


# Rupture Sequence



# Rupture Sequence







# Systemic Problems

- “The multiple and recurring deficiencies in PG&E operational practices indicate a systemic problem.”



# Ineffective Oversight

- “The ineffective enforcement posture of the California Public Utilities Commission permitted PG&E’s organizational failures to continue over many years.”
- PHMSA’s weak monitoring of state safety oversight programs enabled ineffective oversight of California PUC.



# NTSB's Probable Cause

## Pacific Gas and Electric Company's:

- (1) inadequate quality assurance and quality control in 1956 during its Line 132 relocation project, which allowed the installation of a substandard and poorly welded pipe section with a visible seam weld flaw that, over time grew to a critical size, causing the pipeline to rupture during a pressure increase stemming from poorly planned electrical work at the Milpitas Terminal; and
- (2) inadequate pipeline integrity management program, which failed to detect and repair or remove the defective pipe section.



# Contributing to the Accident

- California Public Utilities Commission's (CPUC) and the U.S. DOT's exemptions of existing pipelines from the regulatory requirement for pressure testing, which likely would have detected the installation defects.
- CPUC's failure to detect the inadequacies of PG&E's pipeline integrity management program.



# Failures in multiple layers

Accident



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# PREVENTING ORGANIZATIONAL ACCIDENTS



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# Make Safety a Core Value

“Safety culture is the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment.”

Source: U.S. Nuclear Regulatory Commission



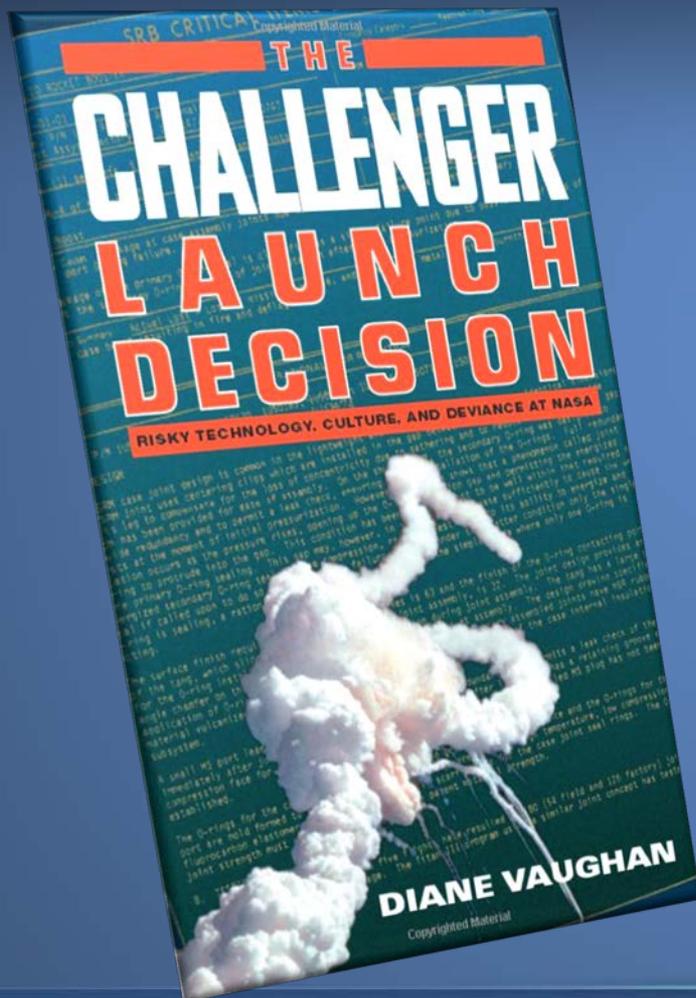
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# Maintain Chronic Unease

- With good safety performance, people/organizations can easily become complacent.
- Don't ever believe that a lack of accidents means you are "safe."
- To counter this complacency, there must be a leadership obsession with continuous improvement.

- Courtesy of Jim Schultz

# Avoid “Normalization of Deviance”



- Normalization of Deviance: When not following procedures and taking “short cuts” and becomes an accepted practice.

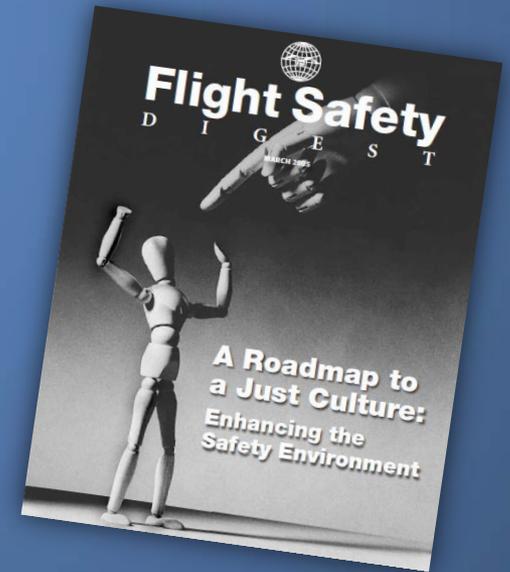


# Just Culture

“An atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior.”

- James Reason, Ph.D.

*Flight Safety Digest*, March 2005



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# Continuous Learning and Risk Awareness

- Organizations with a healthy safety focus are constantly learning.
- They conduct thorough investigations.
- They learn from their mistakes and those of others.
- Information regarding prior incidents and accidents is shared openly and not suppressed.
- They are ever mindful of risks and are looking for ways to mitigate those risks.









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