New England Pipeline Safety Representatives Annual Seminar – Hyannis, Massachusetts San Bruno, CA – Lessons Learned

Randy Knepper
Director of Safety
New Hampshire Public Utilities Commission

 Oct 27, 2011

Topics

- **Impact of the San Bruno Explosion (Overview)**
- MAOP Establishment
- Explosion Images
- Ruptured Segment – Determination of Root Cause
- IMP Risk Ranking
- NTSB Findings
- Public Awareness
- Response Times
- Legislative Implications

San Bruno, CA Overview

- **Worst Gas Pipeline Incident to occur within last 25 years**
- **8 Fatalities including employee (and daughter) of the California Public Utilities Commission**
- **10 people sustained serious injuries**
- **48 people sustained minor injuries**
- **38 homes destroyed**
- **Another 70 homes were damaged, 18 to the extent they were uninhabitable**

San Bruno, CA Overview

- **Estimated over $550 million in property damages and compensation losses**
- **Estimated over $450 million in projected transmission pipeline replacements**
- **Loss of Gas of 48 million cubic feet**
- **Required 600 Fire and EMT First Responders**
- **Required 300 Police First Responders**
- **Numerous agencies involved. Civil cases, criminal cases**

Class action lawsuits

- **National Media Attention**
- **State Legislature Action, Congressional Action**

Investigation Timeline

- **NTSB issued Preliminary Report of Facts Sept 2010 (3)**
- **CPUC hired independent review panel to evaluate state safety program, statutory recommendations and technical assessment of PG&E in regards to management and operations associated with the incident Sept 23, 2010**
- **NTSB issued 3 Urgent Recommendations Jan 3 2011**
- **NTSB issued Materials Lab Factual Report Jan 21, 2011 (77)**
- **NTSB held hearings in March 2011 (3 days)**

Investigation Timeline (cont'd)

- **INGAA issued Preliminary Analysis of Publicly Available Evidence Supporting a Failure Cause of PG&E San Bruno Incident May 5, 2011 (55)**
- **CPUC investigation issued final report June 8, 2011 (196)**
- **NTSB produced final report Sept 26 2011 (140)**

NTSB Preliminary Report

Sept 2010

National Transportation Safety Board
Washington, D.C. 20594

Preliminary Report

Accident No.:	DCA10MP008
Type of System:	30-inch natural gas transmission pipeline
Accident Type:	Pipeline rupture
Location:	San Bruno, CA
Date:	September 9, 2010
Time:	About 6:11 p.m., Pacific Daylight Time
Owner/Operator:	Pacific Gas & Electric Company
Fatalities/Injuries:	Eight fatalities, multiple injuries
Pipeline Pressure:	386 pounds per square inch gauge (psig) at the time of rupture
Quantity Released:	Approximately 47.6 million standard cubic feet (MMSCF)

On September 9, 2010, at approximately 6:11 p.m. Pacific Daylight Time[1], a 30-inch diameter natural gas transmission pipeline (Line 132) owned and operated by Pacific Gas & Electric Company (PG&E) ruptured in a residential area in San Bruno, California. On September 10, the NTSB launched a team to California to investigate this tragedy. Vice Chairman Christopher Hart was the NTSB Board Member on scene in San Bruno.

The rupture on Line 132 occurred near mile post (MP) 39.33, at the intersection of Earl Avenue and Glenview Drive in the city of San Bruno. Approximately 47.6 million standard cubic feet (MMSCF) of natural gas was released as a result of the rupture. The rupture created a crater approximately 72 feet long by 26 feet wide. A pipe segment approximately 28 feet long was found about 100 feet away from the crater. The released natural gas was ignited sometime after the rupture; the resulting fire destroyed 37 homes and damaged 18. Eight people were killed, numerous individuals were injured, and many more were evacuated from the area.

The Incident Command was set up by the local fire department. The immediate response by local emergency responders, as well as three strategic drops of fire retardant and water by air, assisted in stopping the spread of the fire.

1: All times mentioned in this report refer to Pacific Daylight Time, unless otherwise specified.

Docket No. SA-534

Exhibit No. 3-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Metallurgical Group Chairman
Factual Report

(77 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

January 21, 2011

MATERIALS LABORATORY FACTUAL REPORT — Report No. 10-119

A. ACCIDENT

Place : San Bruno, CA
Date : September 9, 2010
Vehicle : Natural Gas Transmission Pipeline
NTSB No. : DCA10MP008
Investigator : Ravi Chhatre, RPH-20

B. COMPONENTS EXAMINED

Three pieces of 30 inch diameter pipe.

C. DETAILS OF THE EXAMINATION

From September 30, 2010 through October 8, 2010, a Metallurgical Group was convened at a facility in Ashburn, VA for the purpose of documenting and examining the ruptured pipeline pieces and determining which portions of the pipe should be removed for further examination at the Materials Laboratory in Washington, DC. Members of the group included:

1) Donald Kramer, Ph.D., Materials Engineer, NTSB
2) Ravindra Chhatre, Investigator in Charge, NTSB
3) Robert Fassett, Director – Integrity Management & Technical Services, PG&E
4) Joshua Johnson, P.E., Materials Engineer, PHMSA Office of Pipeline Safety
5) Sunil Shori, Utilities Engineer, State of California Public Utilities Commission
6) Paul Tibbals, P.E., Sr. Materials Technology Engineer, PG&E

C.1. DOCUMENTATION OF AS-RECEIVED CONDITION

The as-received pipe was comprised of eight lengths of pipe in three separate sections as illustrated by the schematic in figure 1 and the photographs in figures 2-5. The pipeline had a north alignment at this location and the flow of gas was to the north under typical conditions. The southern section of pipe measured 12 foot – 4 inch at its longest point and was comprised of a single piece of long pipe (commonly referred to as a joint[1]) as shown in figure 2. The center section was 27 foot – 8 inch at its longest point and was

[1] A joint is a single length of pipe, typically 20 feet or greater in length.

Preliminary Analysis of Publicly Available Evidence Supporting a Failure Cause of PG&E San Bruno Incident

INGA

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JACOBS Consultancy

Report of the Independent Review Panel
San Bruno Explosion

Prepared For
California Public Utilities Commission

June 8, 2011

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

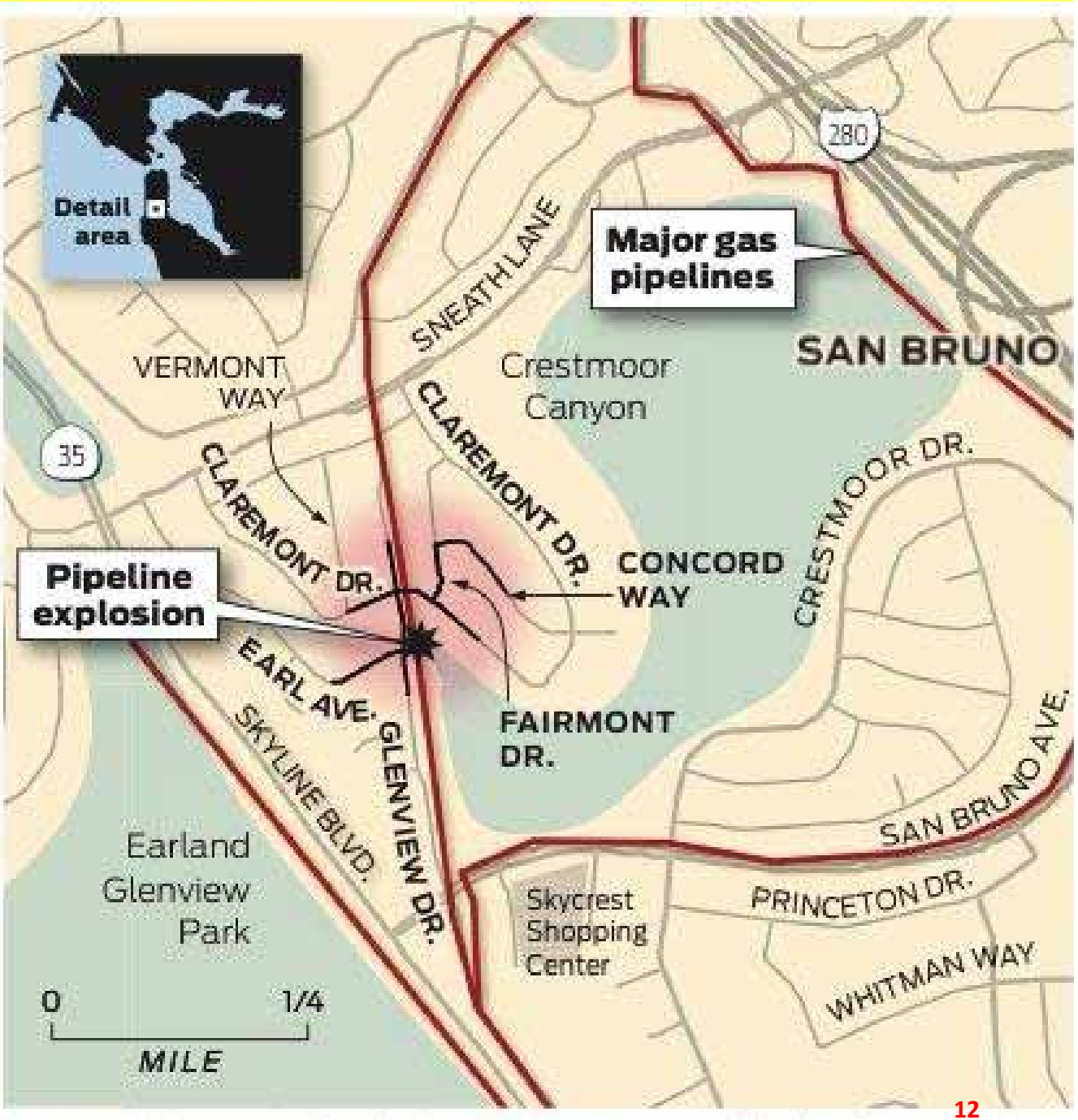
Accident Report

NTSB/PAR-11/01
PB2011-916501

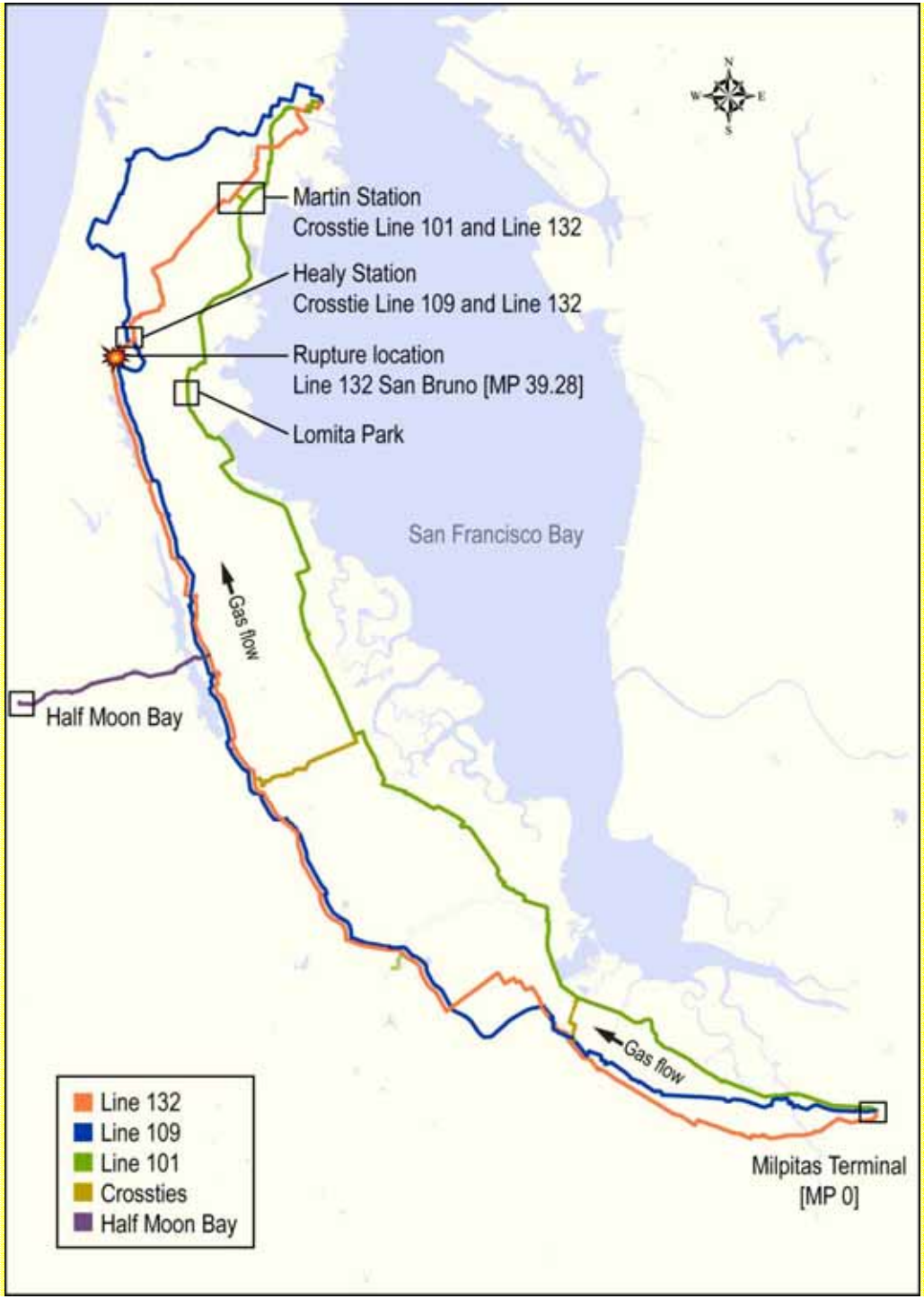
National Transportation Safety Board

San Bruno, CA
The Setting

- Sept 9, 2010
- 3 Intrastate Transmission Pipelines in area
- Operated by PG&E
- 30 inch diameter, .375 wall, API 5L X42
- Approx 400 psig
- Installed 1950's



Sources: ESRI, gas pipeline by Rextag Strategies, neighborhood image by Picto


Martin Station
Crosstie Line 101 and Line 132
Healy Station
Crosstie Line 109 and Line 132
Rupture location
Line 132 San Bruno [MP 39.28]
Lomita Park
San Francisco Bay
Gas flow
Half Moon Bay
Gas flow
Line 132
Line 109
Line 101
Crossties
Half Moon Bay
Milpitas Terminal
[MP 0]

Topics

- Impact of the San Bruno Explosion (Overview)
- **MAOP Establishment**
- Explosion Images
- Ruptured Segment – Determination of Root Cause
- IMP Risk Ranking
- NTSB Findings
- Public Awareness
- Response Times
- Legislative Implications

MAOP and MOP

- MAOP of Line 132 had a Maximum Allowable Operating Pressure of 400 psig
- MOP is an operating limit defined by PG&E. As explained by PG&E, sometimes a line's MOP equals the MAOP. But when a line is crosstied to (open to) a line with a lower MAOP, the higher rated line is limited by the MAOP of the lower rated line. In the case of Line 132, when it was open to Line 109 (which had a MAOP of 375 psig), as it was at the time of the accident, the MOP of Line 132 was 375 psig

Determination of MAOP

- Since the line was installed in 1956 neither State Regulations nor Federal Regulations were in place that required a pressure test (strength test) for Line 132
- Part 192.619 (a) (3) known as the 'Grandfather' clause for pipelines constructed prior to 1970
- Allows for the highest operating pressure established during the previous 5 years (1965 to 1970) to establish MAOP
- PG&E used the Grandfather Clause and the 400 psig operating pressure that occurred Oct 1968 established the MAOP

Determination of MAOP

- NTSB had proposed eliminating the grandfather clause in 1987 in a Safety Recommendation and was recorded in a ANPRM but ultimately rejected by PHMSA predecessor in 1989.
- This could potentially allow some pipelines to be operated at above 72 % SMYS for grandfathered pipelines vs 72% SMYS limitation for non grandfathered pipelines
- It is estimated that 61% of the interstate transmission pipeline nationwide mileage has relied on the Grandfather Clause – no formal hydrotest

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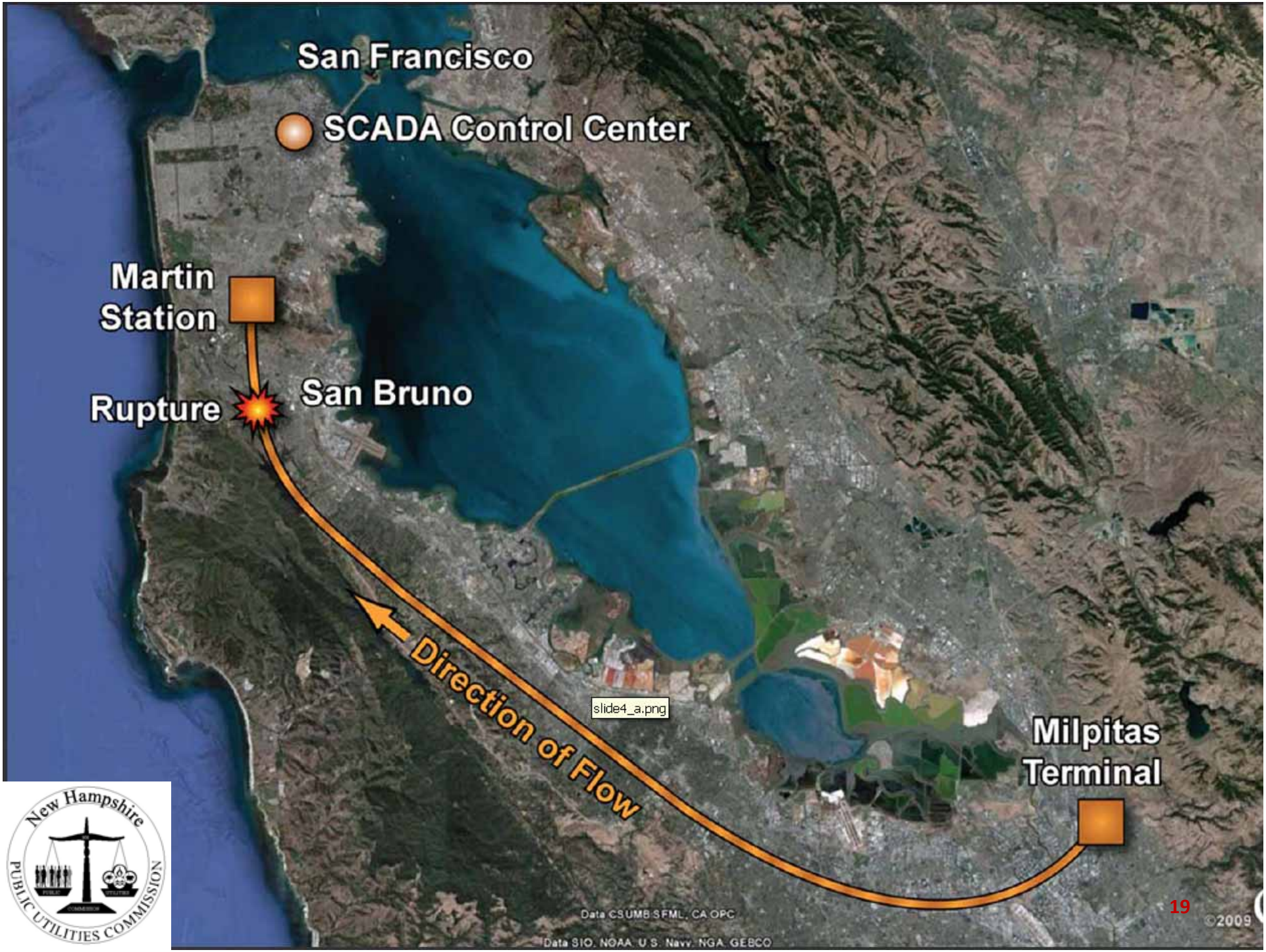
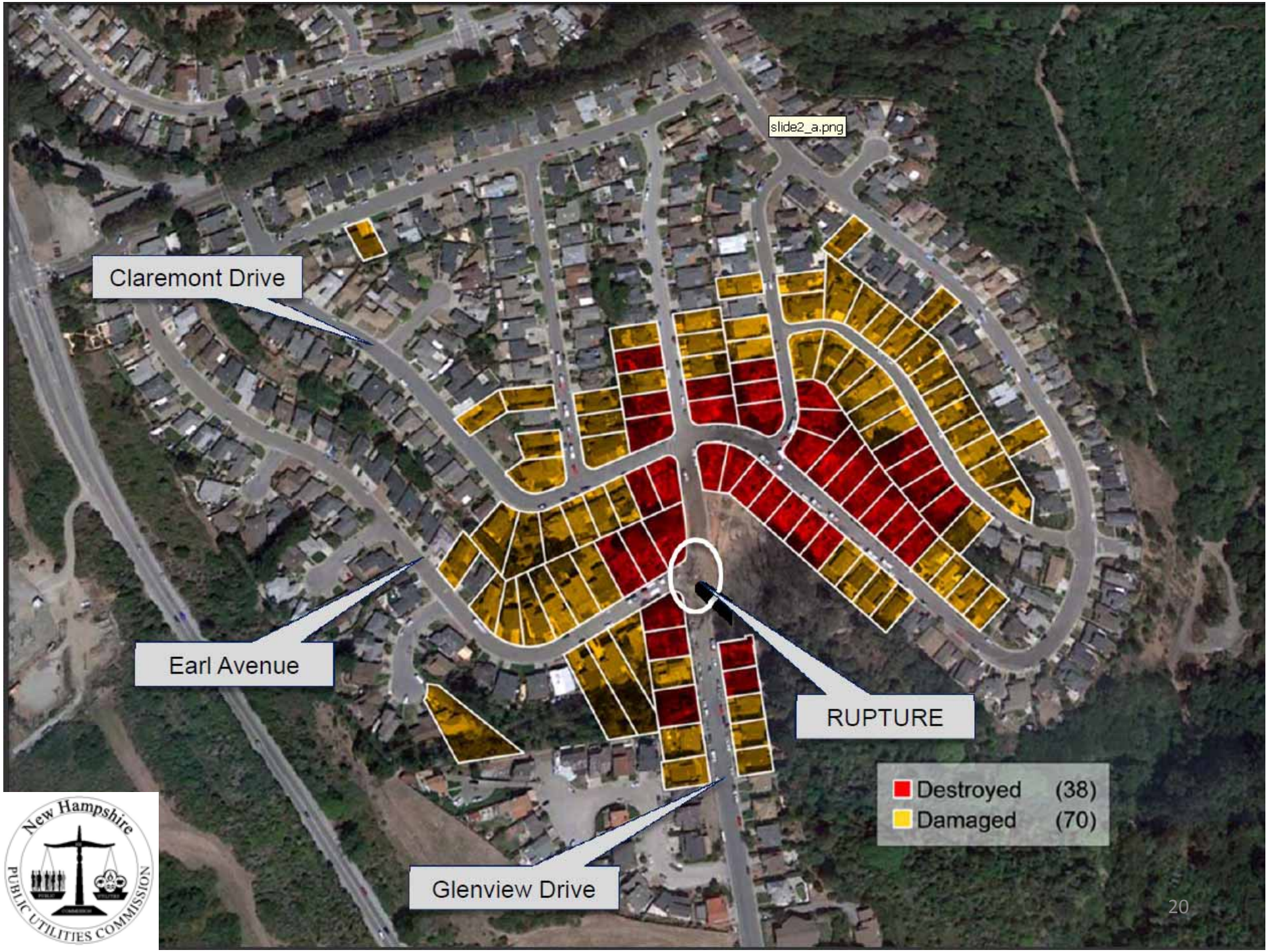
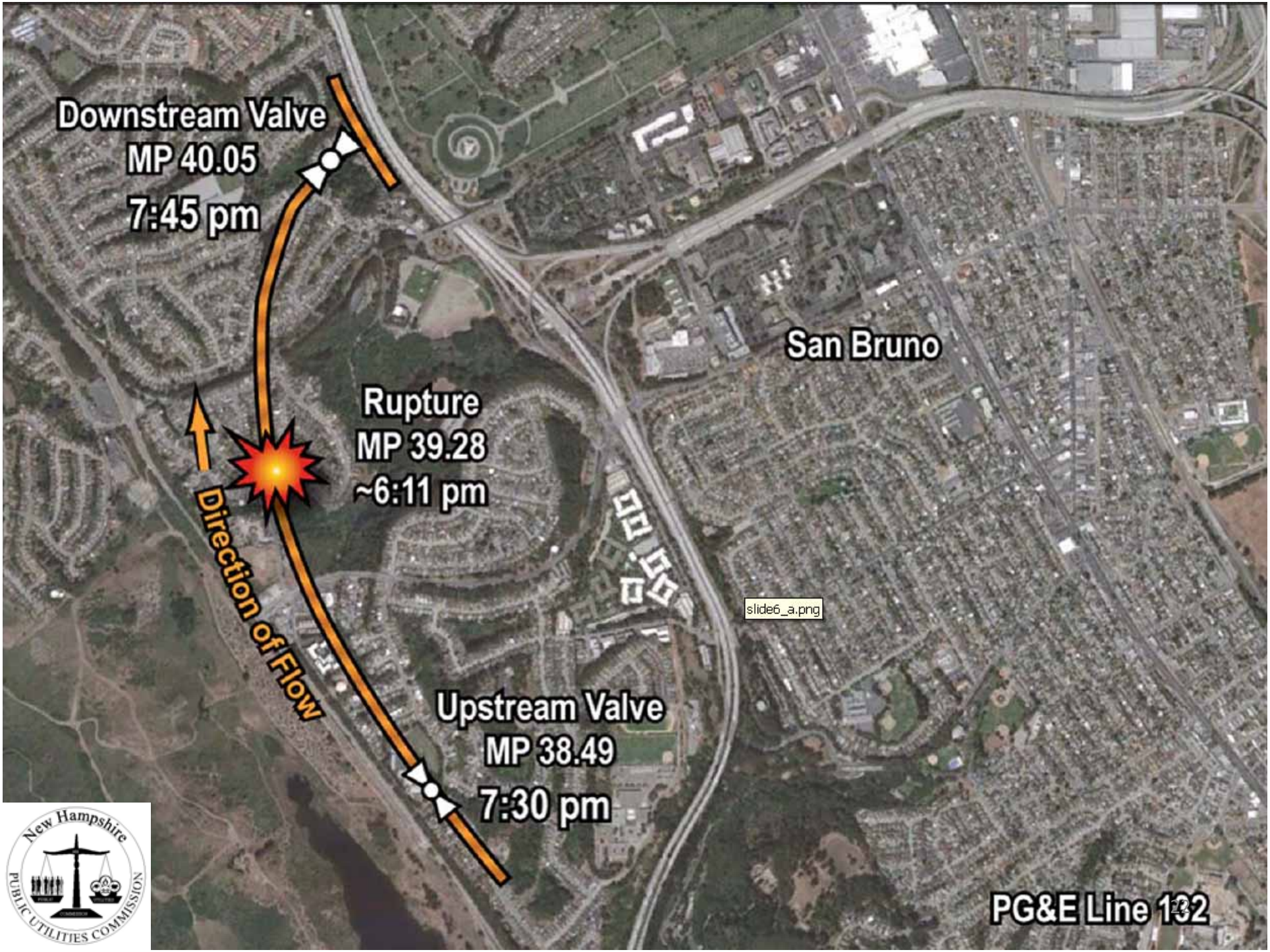
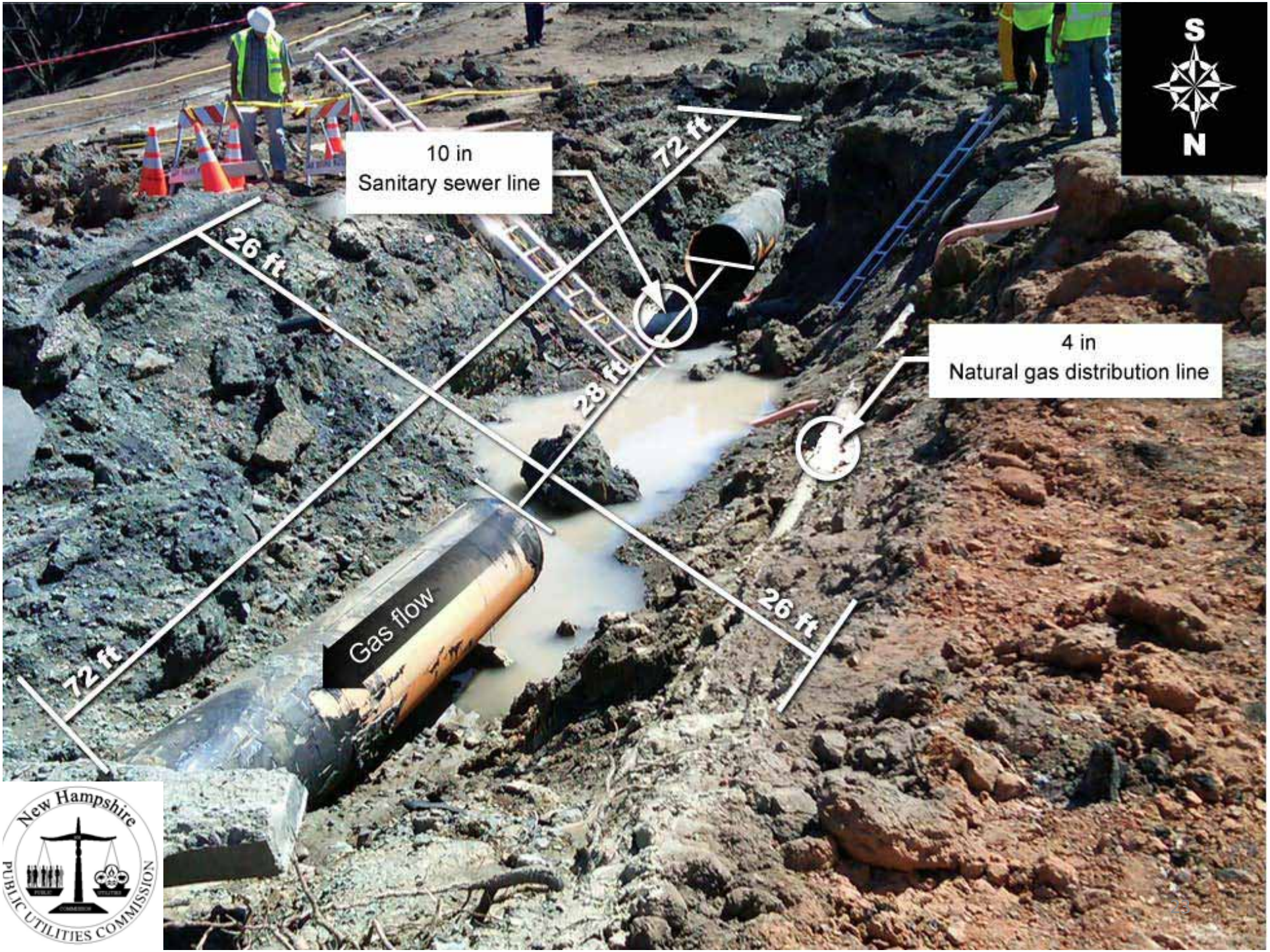

San Francisco
SCADA Control Center
Martin Station
Rupture
San Bruno
Direction of Flow
slide4_a.png
Milpitas Terminal
Data CSUMB SFML, CA OPC
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2009


slide2_a.png
Claremont Drive
Earl Avenue
RUPTURE
Glenview Drive
Destroyed (38)
Damaged (70)

San Bruno - The First Responders


Downstream Valve
MP 40.05
7:45 pm
Rupture
MP 39.28
~6:11 pm
Direction of Flow
Upstream Valve
MP 38.49
7:30 pm
San Bruno
slide6_a.png
PG&E Line 132


S
N
10 in
Sanitary sewer line
72 ft
26 ft
28 ft
4 in
Natural gas distribution line
Gas flow
26 ft
72 ft

San Bruno, CA – Ruptured Pipeline Section blown 100 feet from explosion site

San Bruno CA, - Devastated Neighborhood

San Bruno, CA –Aerial View Post Explosion

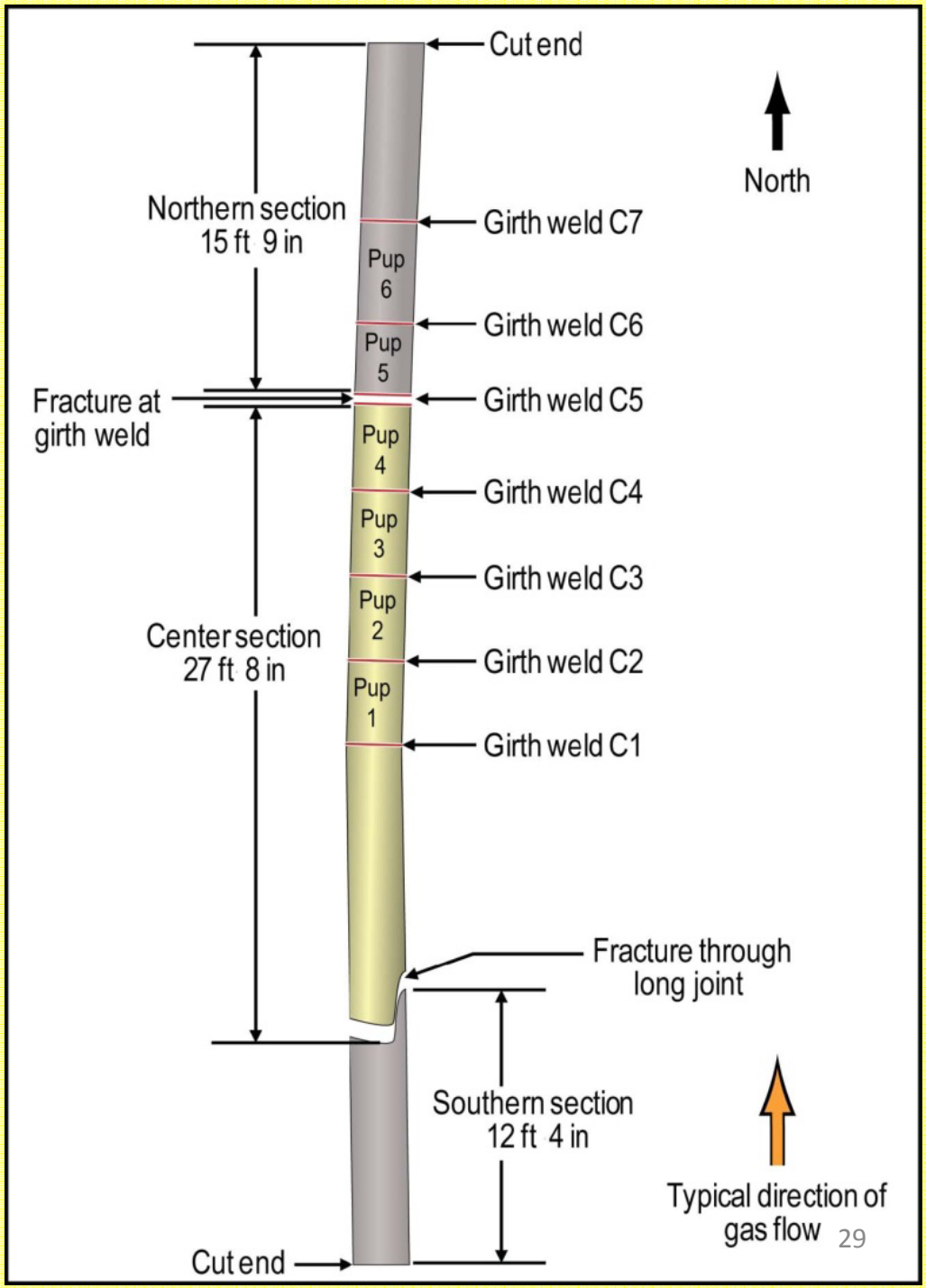
San Bruno, CA – Incinerated Remains of Vehicles

Topics

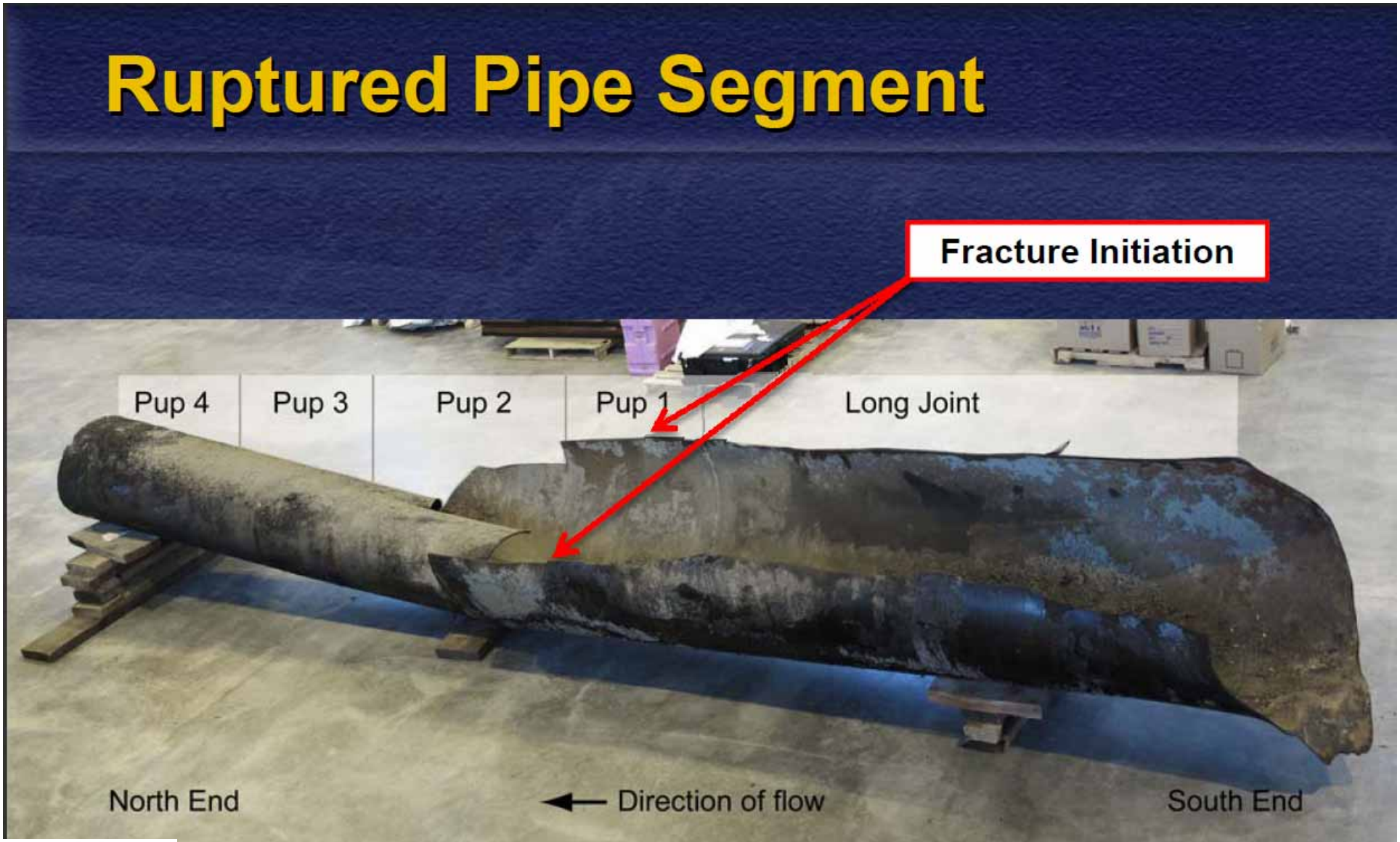
- Impact of the San Bruno Explosion (Overview)
- MAOP Establishment
- Explosion Images
- **Ruptured Segment – Determination of Root Cause**
- IMP Risk Ranking
- NTSB Results
- Public Awareness
- Response Times,
- Record Keeping
- Legislative Implications

Pipeline Segment that Failed

- Pup pieces were approximately 3.5 feet to 4 feet long (.375 in wall)
- .312 in wall at the north end



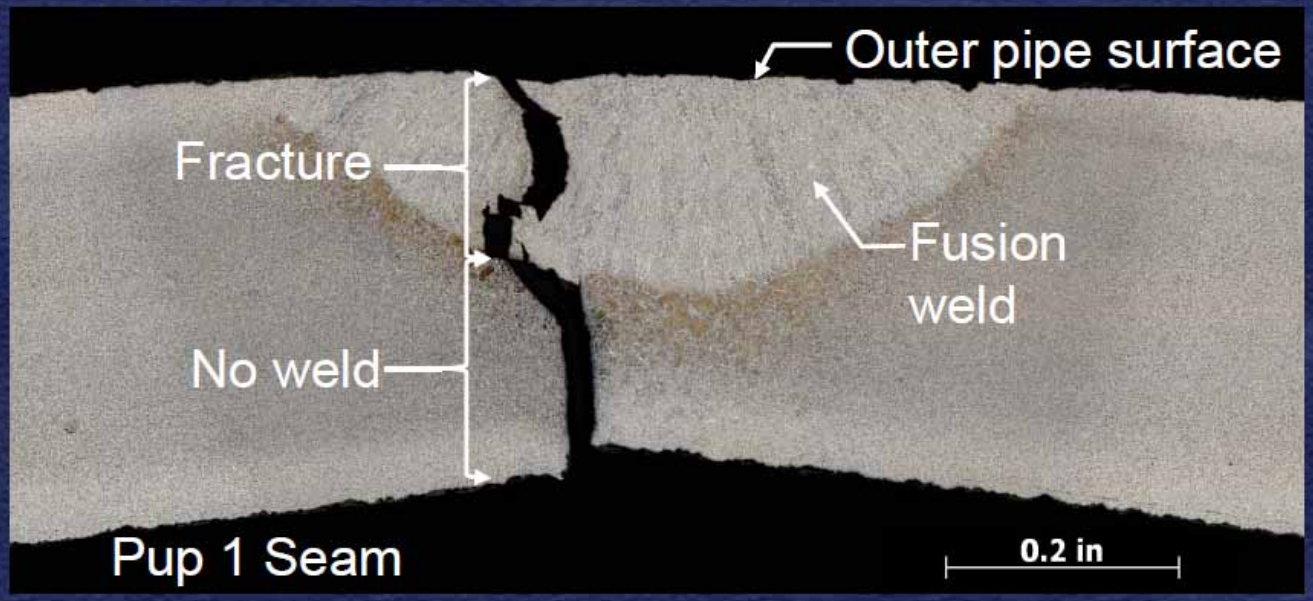
Ruptured Pipe Segment



Rupture Examination Welding

- Pup 1, Pup 2, Pup 3 had a seam weld
- A close examination of those welds compared to typical weld methods begin to reveal some clues
- The next slide is a closeup of Pup 1 Seam Weld
- While a typical DSAW weld is shown below

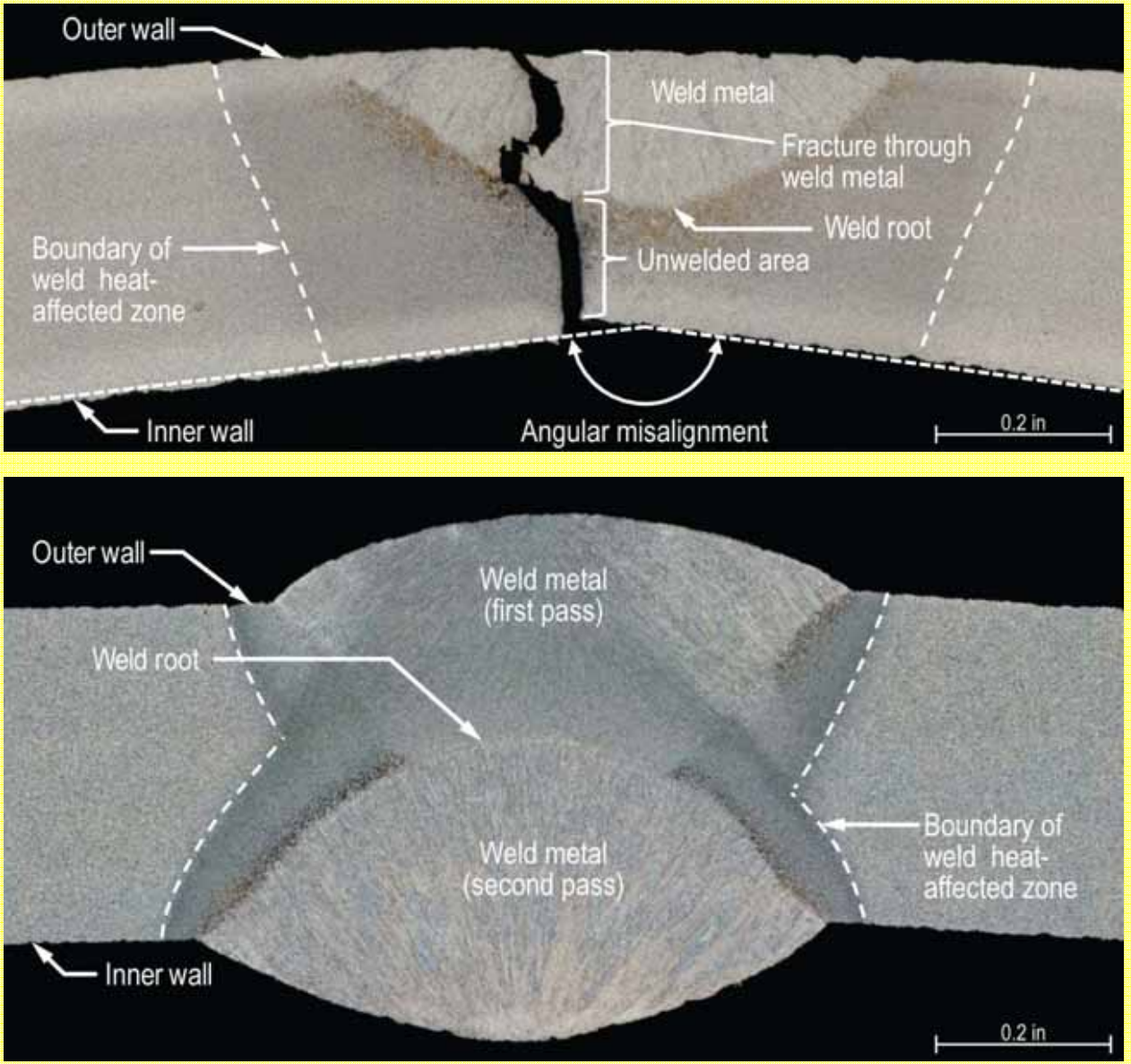
Cross Section of Pipe Seams



New Hampshire Public Utilities Commission

NTSB

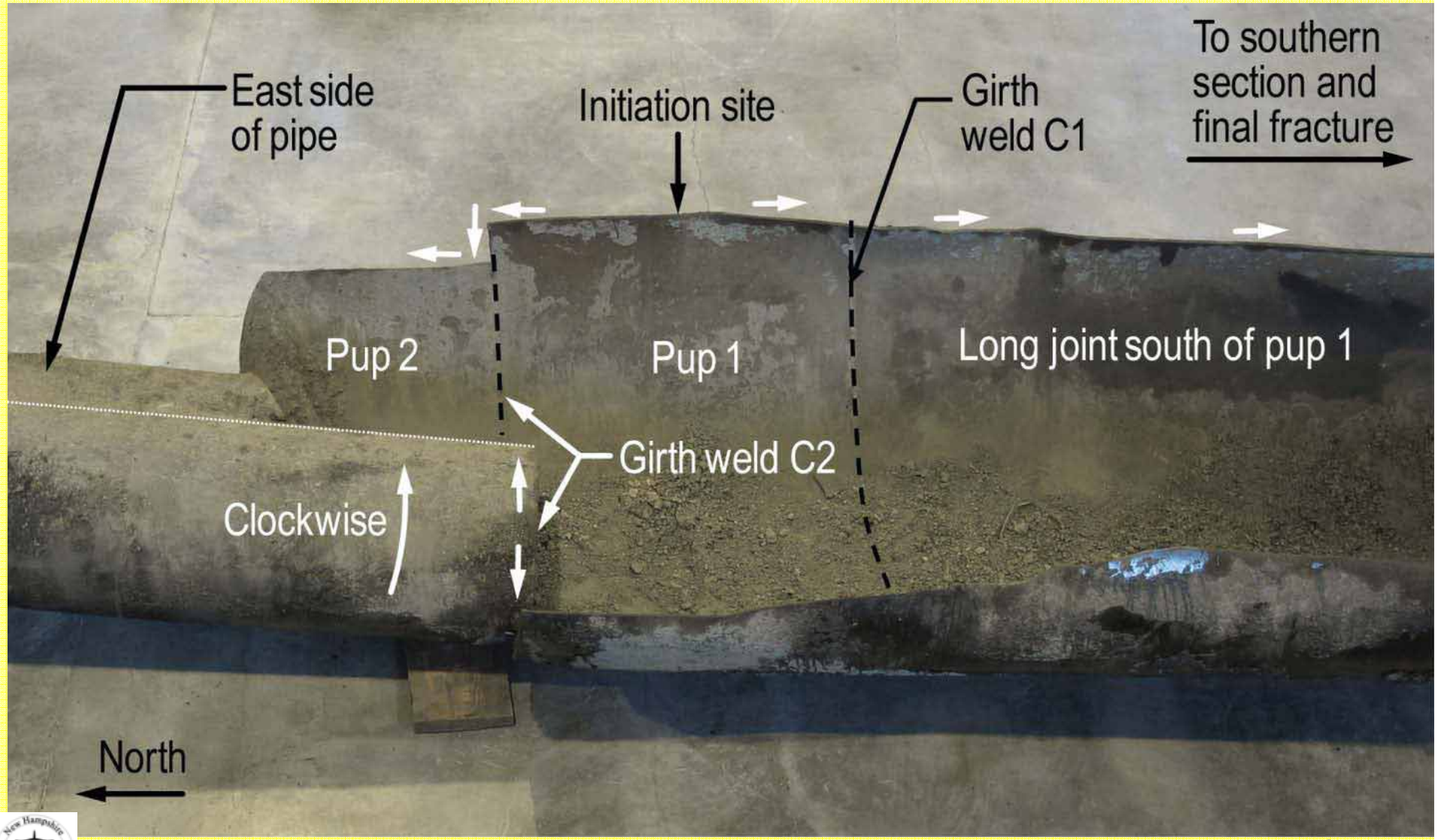
Rupture Examination Welding



Rupture Examination Welding

- Welds showed indications of different Welding Methods such as Fusion Welding Process, Manual Arc Welding, Shielded Metal Arc Welding on Girth Welds (Field)
- Double Submerged Arc Welding (Factory)
- Evidence of Porosity, incomplete fusion, undercutting, Lack of Penetration, slag inclusion
- Squared Ends versus Beveled Ends

Location of Initiation of Cracks



Material Properties

- PG&E Pipe Spec use X42 SMYS or X52 SMYS

Specification	Minimum Yield Strength (ksi)	Minimum Tensile Strength (ksi)	Minimum Elongation (percent in 2 inch)
7R-61963 PG&E material specification	52.0	72.0	22
API 5LX X52, 1954	52.0	66.0	20
API 5LX X42, 1954	42.0	60.0	25

Sample	Yield Strength[a] (ksi[b])	Tensile Strength (ksi)	Elongation (percent in 2 inch)
South long joint	57.0 ± 0.6	83.2 ± 0.3	30.0 ± 0.7
Pup 1	36.6 ± 0.3	63.6 ± 0.2	39.4 ± 0.5
Pup 2	32.0 ± 0.1	52.0 ± 0.0	48.8 ± 0.8
Pup 3	34.9 ± 0.5	60.3 ± 0.3	42.8 ± 0.4
Pup 4	48.3 ± 0.5	79.0 ± 0.0	34.0 ± 0.7
Pup 5	38.5 ± 0.3	71.8 ± 0.3	35.8 ± 1.1
Pup 6	50.5 ± 1.4	78.7 ± 0.3	30.8 ± 0.8
North long joint	54.0 ± 0.4	76.9 ± 0.2	30.4 ± 0.5

Wait a second!!!

- I thought you said X42 or X52
- Do you mean you are not sure what type of pipe you used?
- Uh oh – I am beginning to wonder about Record Keeping.
- My Concern is now your concern!!!

Official Probable Cause

- NTSB determines that the probable cause of the accident was the Pacific Gas and Electric Company's (PG&E) (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*…..

Topics

- Impact of the San Bruno Explosion (Overview)
- MAOP Establishment
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- **IMP Risk Ranking**
- NTSB Results
- Public Awareness
- Emergency Response Times,
- Record Keeping
- Legislative Implications

Integrity Management Implications

- Part 192.917(e) addresses required actions for particular threats.
- It is one of the integrity management program rules that became effective in 2004
- One type of threat is manufacturing and construction defects
- Categorizes them into stable threats and instable threats

Integrity Management Implications

Manufacturing and construction defects. If an operator identifies the threat of manufacturing and construction defects (including seam defects) in the covered segment, an operator must analyze the covered segment to determine the risk of failure from these defects. The analysis must consider the results of prior assessments on the covered segment.

Integrity Management Implications

An operator may consider manufacturing and construction related defects to be **stable defects** **if the operating pressure on the covered segment has not increased over the maximum operating pressure experienced during the five years preceding identification of the high consequence area.** If any of the following changes occur in the covered segment, an operator must prioritize the covered segment as a high risk segment for the baseline assessment or a subsequent reassessment.

- (i) Operating pressure increases above the maximum operating pressure experienced during the preceding five years;
- (ii) MAOP increases; or
- (iii) The stresses leading to cyclic fatigue increase.

Integrity Management Implications

- PG&E had a practice of raising the operating pressure to MAOP once every 5 years on several of its pipelines, including Line 132 and the other peninsula lines (Lines 101 and 109), as a strategy to continue classifying any manufacturing and construction defects on those lines as "stable," meaning that they were not anticipated to grow in service.

Integrity Management Implications

- PG&E believed under certain circumstances where the operating pressure is raised above the maximum pressure experienced during the preceding [5] years, PHMSA regulations … require the operator to schedule a priority assessment capable of assessing seam integrity.
- PG&E believed in these circumstances, ASME B31.8S calls for a hydrostatic pressure test, which would take a line out of service for a period of at least a week.
- To avoid this and any potential customer curtailments that may result, PG&E has operated, within the applicable 5-year period, some of its pipelines that would be difficult to take out of service at the maximum pressure experienced during the preceding 5-year period in order to meet peak demand and preserve the line's operational flexibility.
- So in 2003 and 2008 Line 132 was raised to 400 psig at the Milpitas Terminal

Integrity Management Implications

- the practice of “artificially raising the pressure in a pipe that has identified integrity seam issues seems to be a wrong-headed approach to safety.” CPUC at NTSB hearing March 2011
- PHMSA officials were unaware of any other operators following such a practice.
- The principal challenge for deciding whether or not to consider manufacturing defects to be stable is associated with those gas pipelines that have never been subjected to a hydrostatic test to a minimum of 1.25 times MAOP…. *from PHMSA Report 2007 O5-12 R*

Integrity Management Implications

- *"an integrity management program without integrity," NTSB Chairwoman Deborah Hersman*

  NTSB Board Hearing Aug 29, 2011

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- IMP Risk Ranking
- **NTSB Results**
- Response Times,
- Record Keeping
- Legislative Implications

Official Probable Cause

and….

- NTSB determines that the probable cause of the accident was (2) inadequate pipeline integrity management program, which failed to detect and repair or remove the defective pipe.

Investigation Timeline (cont'd)

- **INGAA issued Preliminary Analysis of Publicly Available Evidence Supporting a Failure Cause of PG&E San Bruno Incident May 5, 2011 (55)**
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Preliminary Analysis of Publicly Available Evidence Supporting a Failure Cause of PG&E San Bruno Incident

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Preliminary Analysis of Publicly Available
Evidence Supporting a Failure Cause of the PG&E San Bruno Incident May 5, 2011

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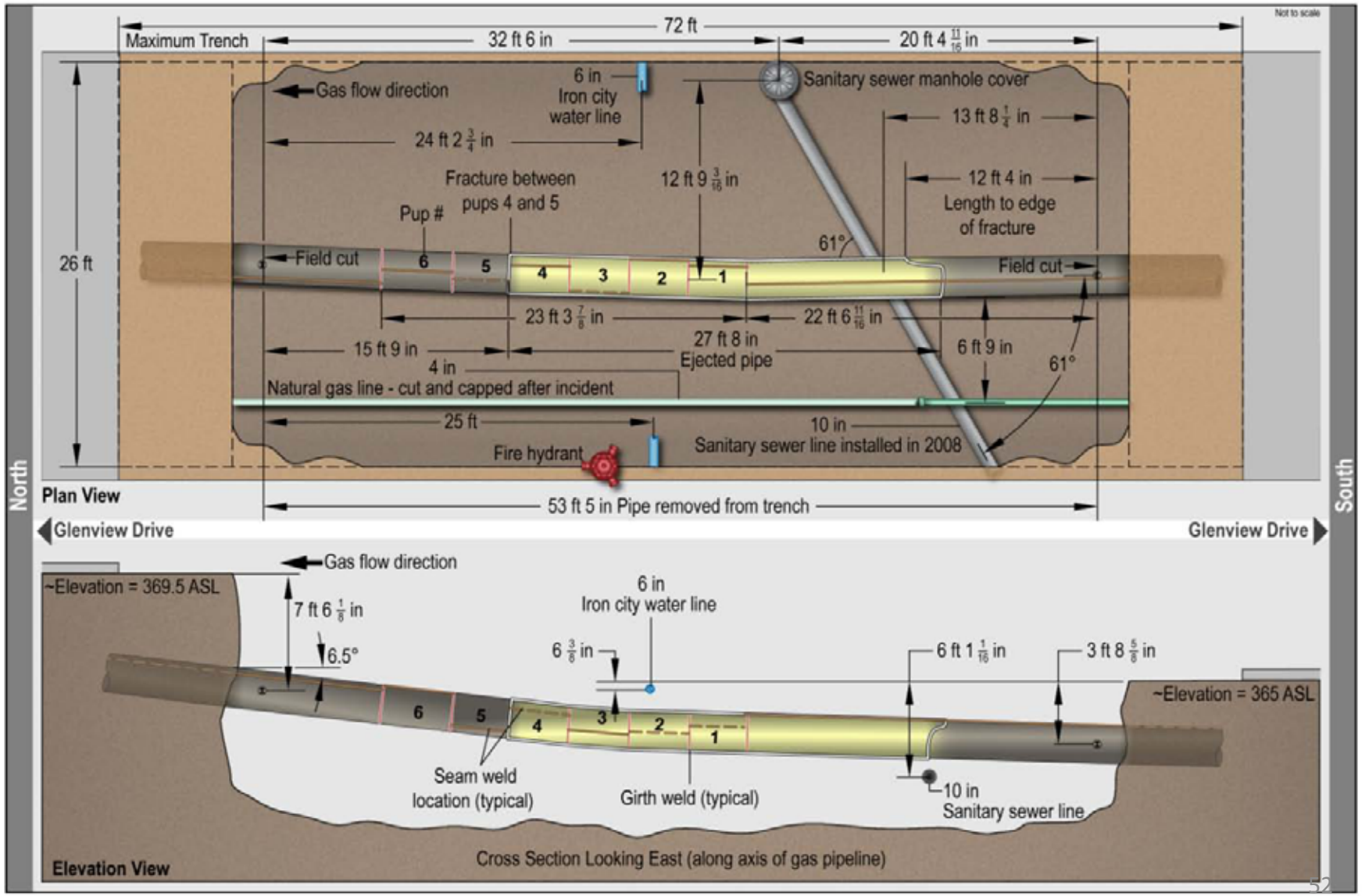
Key Findings

1. Both the material and the fabrication welds of the section of pipeline that failed in San Bruno did not meet the engineering consensus standards applicable to natural gas transmission pipelines and the PG&E specifications in effect at the time of construction.
2. A hydrostatic pressure test of the pipeline probably would have detected the initial weld seam defect and low material strength of the fabricated pipe section. Fatigue analysis of the failed pipeline section suggests that an external force was necessary to cause further deterioration of the initial longitudinal weld seam flaw.
3. Assuming both that our analysis is correct and that the public record reflects all material facts, the external event that most likely caused increased stress on the longitudinal weld seam of Pup #1 was a 2008 sewer replacement project.

From NTSB Report



How did the Fracture Occur?

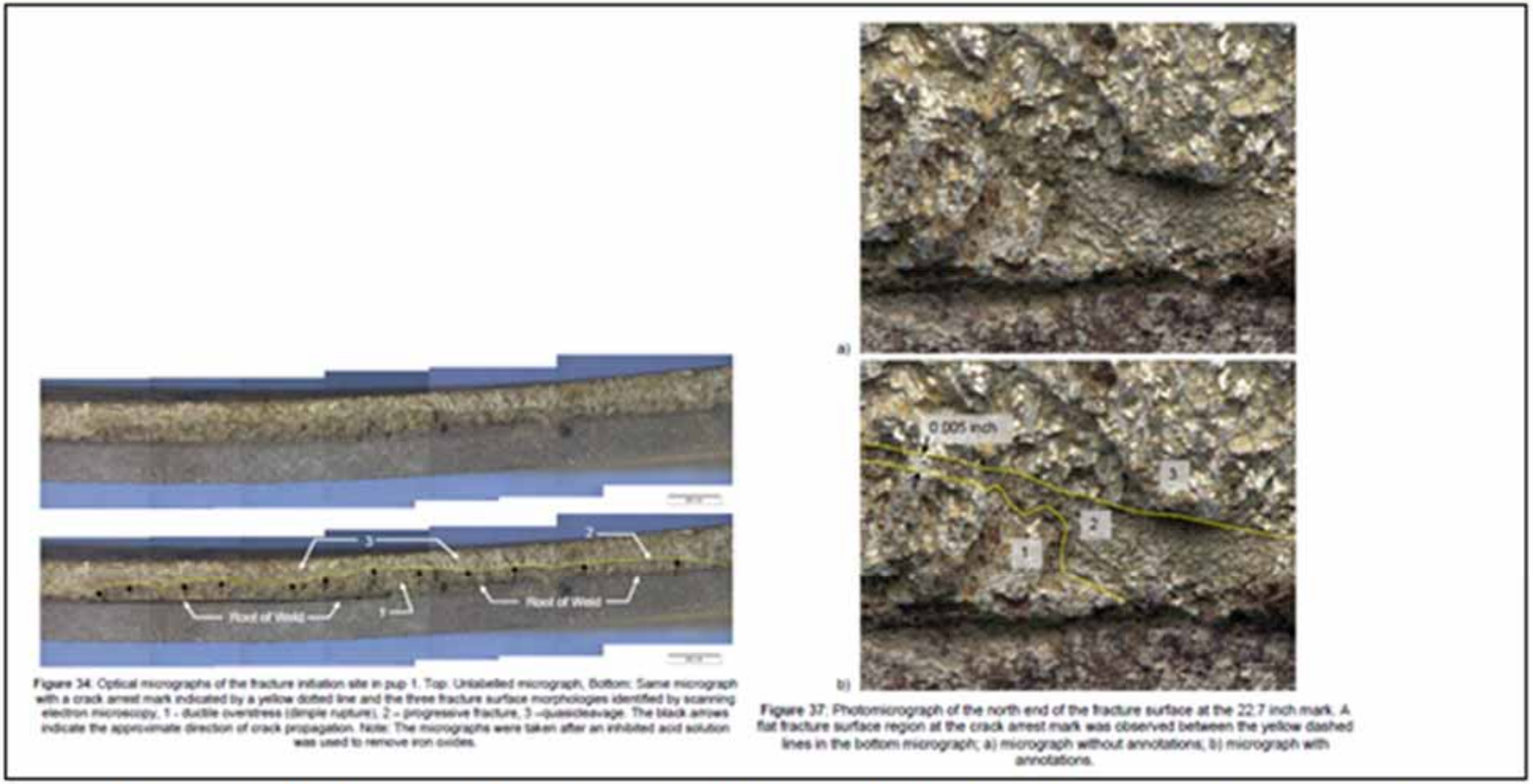


Figure 34. Optical micrographs of the fracture initiation site in pup 1. Top: Unlabeled micrograph, Bottom: Same micrograph with a crack arrest mark indicated by a yellow dotted line and the three fracture surface morphologies identified by scanning electron microscopy, 1 – ductile overstress (dimple rupture), 2 – progressive fracture, 3 –quasicleavage. The black arrows indicate the approximate direction of crack propagation. Note: The micrographs were taken after an inhibited acid solution was used to remove iron oxides.

Figure 37. Photomicrograph of the north end of the fracture surface at the 22.7 inch mark. A flat fracture surface region at the crack arrest mark was observed between the yellow dashed lines in the bottom micrograph; a) micrograph without annotations; b) micrograph with annotations.

Figure 1. Source: NTSB Metallurgical Report 3A, exhibit 459184. The NTSB photos show the lack of penetration, the ductile Zone 1 and striated Zone 2.

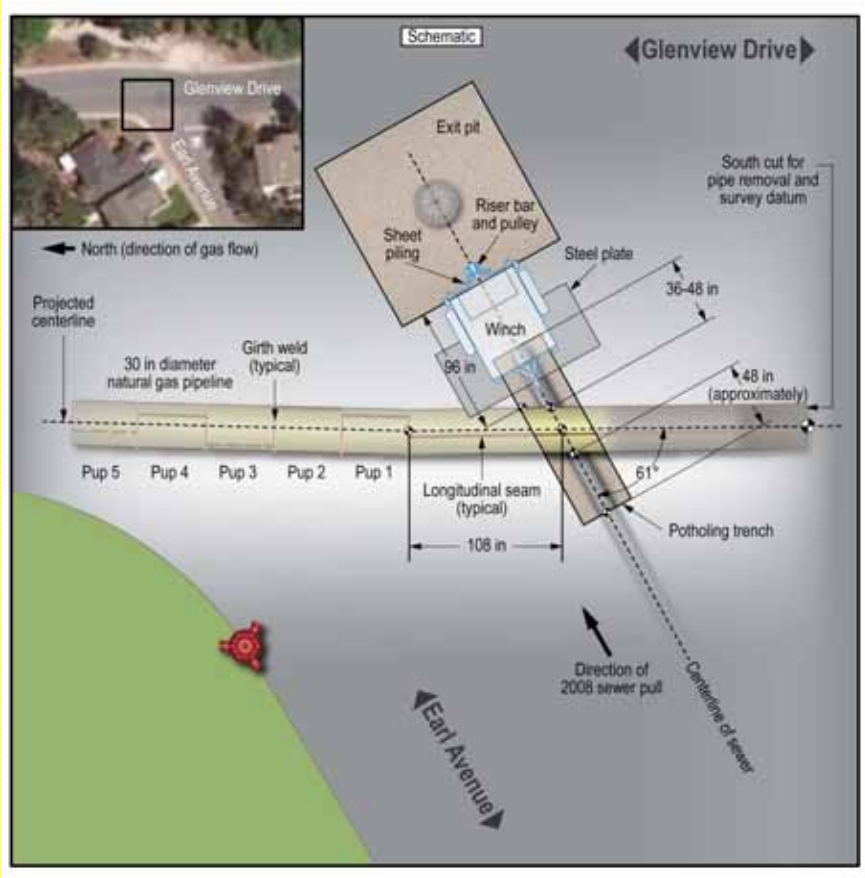
Subsequent NTSB Final Report

- NTSB discounted the effect of the Sewer installation as a root cause of the failure
- Considered video of jacking operation
- Considered Studies on pipe bursting by Army Corp of Engineers 2001 and 2004 Paper at North American Trenchless Technology regarding Vibrations
- Found equivalent stress on pipe was raising internal hoop stress to approximately

  6 psi due to bursting head

  2.5 psi due to external soil pressure

  .01 psi due to vibrations
- Considered **minimal** compared to the pressure variations within the pipe of 110 psi



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- NTSB Results
- **Public Awareness**
- Response Times,
- Record Keeping
- Legislative Implications

Ineffective Public Awareness

- Part 192.616 requires continual improvement, effectiveness evaluation at least every 4 years
- In 2010 PG&E hired outside firm to conduct a program documentation review.
- Relied on “statistical sampling” of affected public
- Mailed 15,302 brochures with returnable postcards to address near ROW and other stakeholders
- Response was only 20 postcards
- Of the responses 14 of 20 stated they had never heard of any pipeline safety information within last 2 years

Failed Public Awareness Campaign

Table 6. Survey postcard responses to public awareness brochures.

Question	Yes	No	Blank
Do you or someone you know work or live near a pipeline?	7	9	4
Have you seen any information about pipeline safety within the last two years?	3	14	3
If you noticed what appears to be a pipeline leak, would you call 911?	17	0	3
Have you or anyone you know ever discovered a buried pipeline while digging?	17	0	3
Have you ever heard of the "One-Call" system before reading this brochure?	2	14	3[a]

[a] In Paradigm's report, only 19 responses to this question were documented.

- PG&E participated in larger API consortium study in 2007
- PG&E had the worst results within the pool
- 89% of 155 respondents did not recall receiving information
- Only 34% were somewhat informed or well informed

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- Public Awareness
- **Response Times**
- Record Keeping
- Legislative Implications

Emergency Response Timeline (1)

- 6:11 pm call to 911
- Fire, gas station explosion, possible airline crash
- 6:12 pm Police arrive on scene
- 6:13 pm Fire Dept on scene (less than 300 yds away)
- 6:18 pm off duty PG&E employee notified PG&E dispatch of explosion
- 6:23 pm dispatch sent PG&E service tech from approximately 8 miles away
- 6:24 pm Fire Reported fire hydrants were dry (resulted from damaged water line)

Emergency Response Timeline (2)

- 6:27 pm PG&E Dispatch asks PG&E SCADA center if pressure drop observed
- 6:30 pm PG&E SCADA center realizes the there was a pressure drop on Line 132, a possible rupture and possible reported over pressurization at the Milpitas terminal to the South
- 6:30 pm Incident Commander of Fire Dept declares a multi casualty scene at Earl Ave, Claremont Drive and Glenwood Drive neighborhood
- 6:40 pm first off duty PG&E employee (supervisor) arrives at scene (was on his way home) Seconds later the PG&E Service Tech arrives on scene.

Emergency Response Timeline (3)

- 6:48 pm call by on scene PG&E to PG&E Dispatch requesting assistance from gas and electric crews
- 6:55 pm PGE Emergency Center was activated
- 7:06 pm PG&E mechanics left nearest yard to shut off southern valve
- 7:20 pm PG&E mechanics arrived at valve and begin to manually shutoff southern valve
- 7:30 pm PG&E mechanics arrived at valve and begin to manually shutoff southern valve

Emergency Response Timeline (4)

- 7:22 pm call by on scene PG&E to PG&E Dispatch confirming gas fire and Line 132 involved
- 7:27 pm PG&E on scene requested Scada Center to shutoff Remote Controlled Valves located at Martins Terminal (north)
- 7:29 pm Remote Controlled Valves were shutoff by Scada Center
- 7:42 pm fire diminished to a level that fire fighters could approach the rupture area
- 7:46 pm PG&E mechanics shutoff valves on northern side manually at Healy Station

Emergency Response

- 7:57 pm PG&E engineer confirmed location of rupture to Scada Center and that cross ties to Line 109 had been opened at the Martins Station to keep Line 100 active.
- 7:57 pm Red Cross set up shelter
- 11:32 pm more PG&E crews squeezing off distribution lines to limit gas fed house fires
- 4:24 am Sept 11, 2010 75% all house fires knocked down
- 8:00 pm Sept 11 Incident Command transferred to PD and FD monitoring hot spots

NTSB Overall Review of ER

1. PG&E took 95 minutes to stop the flow of gas and to isolate the rupture site—a response time that was *excessively long* and contributed to the extent and severity of property damage and increased the life-threatening risks to the residents and emergency responders.
2. The National Transportation Safety Board found that PG&E *lacks a detailed and comprehensive procedure for responding to large-scale emergencies* such as a transmission pipeline break, including a defined command structure that clearly assigns a single point of leadership and allocates specific duties to supervisory control and data acquisition staff and other involved employees.

NTSB Overall Review of ER

3. PG&E's *supervisory control and data acquisition system limitations caused delays in pinpointing the location* of the break.

4. The use of either automatic shutoff valves or remote control valves would have reduced the amount of time taken to stop the flow of gas.

NTSB Specific findings of ER

- PG&E's SCADA center communication protocols did not use Incident Command System, lack of centralized command structure
- Lack of assigned roles and responsibilities led to not allocating their time and attention in the most effective manner
- Unnecessary overlap and duplication of efforts was demonstrated
- PG&E explanation for not using Remote Control Valves or Automated Control Valves was contradictory to 192.

NTSB Specific findings of ER

- PG&E explanation for not using Remote Control Valves or Automated Control Valves was contradictory to 192.935(c) Integrity Management Requirements and was inconsistent with non industry sponsored studies
- 192.935(c), "[i]f an operator determines, based on a risk analysis, that an ASV or RCV would be an efficient means of adding protection to a high consequence area in the event of a gas release, an operator must install the ASV or RCV."

CPUC Report

- CPUC Report stated that sewer work conducted by City of San Bruno in 2008 could have triggered the threat from “stable” to “unstable”
- CPUC report emphasized the breakdown of communications within PG&E regarding field work and integrity management responsibilities in regards to potential of failure

NTSB San Bruno Incident Sept 2010 -28 Findings as it relates to Operator, State Regulator, Federal Regulator

- **Findings 1-23 have specific findings of PGE about**
  - **the Cause of the incident**
  - **Lack of contingency plan for associated work on nearby pipeline facility**
  - **No incident command system used for control center**
  - **Scada system contributed to added to delays in response**
  - **Use of Automated and Remote Control Valves would have reduced impact**
  - **Excessively long response times experienced**
  - **Ineffective public awareness plan**
  - **Ineffective post accident for drug & alcohol testing**
  - **Deficient Integrity Management Program with Inadequate Record Keeping and treatment of unstable threats**

NTSB San Bruno Incident Sept 2010 -28 Findings as it relates to Operator, State Regulator, Federal Regulator

- **Findings 24-28 have 5 specific findings about**
  - **PHMSA and State Regulator regarding:**
    - **Ineffective IMP Inspection Protocols used during Inspection Process**
    - **Not able to evaluate IMP Program without establishing meaningful metrics**
    - **Improvement required of PHMSA regarding monitoring oversight of State Inspection Program**
    - **State Regulator had weak enforcement policy**

NTSB Findings

1. The following were not factors in this accident: seismic activity, corrosion, direct third-party damage, or drug use by the workers at the Milpitas Terminal.

2. The accident pipe comprising the pups did not conform to PG&E or other known specifications for pipe and was fabricated at an undetermined facility to no known specification.

3. The accident pipe would not have met generally accepted industry quality control and welding standards in 1956, indicating that those standards were overlooked or ignored.

4. PG&E's inadequate quality control during the 1956 relocation project led to the installation and commissioning of a defective pipe that remained undetected until the accident, 54 years later.

5. The fracture of Line 132 Segment 180 originated in the partially welded longitudinal seam of pup 1, which was progressively weakened due to ductile crack growth and fatigue crack growth.

NTSB Findings

6. The combination of the size and shape of the weld defect significantly reduced the strength of the pup 1 longitudinal seam, making it susceptible to unstable crack growth under internal gas pressure.

7. The 2008 sewer line installation did not damage the defective pipe that later ruptured.

8. The internal line pressure preceding the rupture did not exceed the PG&E maximum allowable operating pressure for Line 132 and would not have posed a safety hazard for a properly constructed pipe.

9. Had a properly prepared contingency plan for the Milpitas Terminal electrical work been in place and been executed, the loss of pressure control could have been anticipated and planned for, thereby minimizing or avoiding the pressure deviations.

10. PG&E lacked detailed and comprehensive procedures for responding to a large-scale emergency such as a transmission line break, including a defined command structure that clearly assigns a single point of leadership and allocates specific duties to supervisory control and data acquisition staff and other involved employees.

NTSB Findings

11. PG&E's supervisory control and data acquisition system limitations contributed to the delay in recognizing that there had been a transmission line break and quickly pinpointing its location.

12. The 95 minutes that PG&E took to stop the flow of gas by isolating the rupture site was excessive.

13. Use of automatic shutoff valves or remote control valves along the entire length of Line 132 would have significantly reduced the amount of time taken to stop the flow of gas and to isolate the rupture.

14. Considering the challenges of the prolonged fire fueled by natural gas, the emergency response was well coordinated and effectively managed by local responders.

15. The 6-hour delay before ordering drug and alcohol testing, the commencement of alcohol testing at the Milpitas Terminal 1 hour after it was no longer permitted, the failure to properly record an explanation for the delay, and the failure to conduct drug or alcohol testing on the supervisory control and data acquisition center staff all demonstrate that the PG&E postaccident toxicological program was ineffective.

NTSB Findings

16. If the grandfathering of older pipelines had not been permitted since 1961 by the California Public Utilities Commission and since 1970 by the U.S. Department of Transportation, Line 132 would have undergone a hydrostatic pressure test that would likely have exposed the defective pipe that led to this accident.

17. There is no safety justification for the grandfather clause exempting pre-1970 pipelines from the requirement for post construction hydrostatic pressure testing.

18. The premise in Title 49 Code of Federal Regulations Part 192 of the Federal pipeline safety regulations that manufacturing and construction-related defects can be considered stable even when a gas pipeline has not been subjected to a pressure test of at least 1.25 times the maximum allowable operating pressure is not supported by scientific studies.

19. The PG&E gas transmission integrity management program was deficient and ineffective.

20. PG&E's public awareness program self-evaluation was ineffective at identifying and correcting deficiencies.

NTSB Findings

21. The deficiencies identified during this investigation are indicative of an organizational accident.

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

23. Because in-line inspection technology is not available for use in all currently operating gas transmission pipeline systems, operators do not have the benefit of a uniquely effective assessment tool to identify and assess the threat from critical defects in their pipelines.

24. The Pipeline and Hazardous Materials Safety Administration integrity management inspection protocols are inadequate.

25. Because PG&E, as the operator of its pipeline system, and the California Public Utilities Commission, as the pipeline safety

regulator within the state of California, have not incorporated the use of effective and meaningful metrics as part of their performance -based pipeline safety management programs, neither PG&E nor the California Public Utilities Commission is able to effectively evaluate or assess the integrity of PG&E's pipeline system..

NTSB Findings

26. Because the Pipeline and Hazardous Materials Safety Administration has not incorporated the use of effective and meaningful metrics as part of its guidance for effective performance-based pipeline safety management programs, its oversight of state public utility commissions regulating gas transmission and hazardous liquid pipelines needs improvement.

27. The ineffective enforcement posture of the California Public Utilities Commission permitted PG&E's organizational failures to continue over many years.

28. The Pipeline and Hazardous Materials Safety Administration's enforcement program and its monitoring of state oversight programs have been weak and have resulted in lack of effective Federal oversight and state oversight exercised by the California Public Utilities Commission.

Topics

- Impact of the San Bruno Explosion (Overview)
- MAOP Establishment
- Explosion Images
- Ruptured Segment – Determination of Root Cause
- IMP Risk Ranking
- NTSB Results
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- Response Times
- **Record Keeping**
- Legislative Implications

Record Keeping

- Integrity Management Concepts depend on Risk Management Concepts which are only as good as the data and records that are input
- Urgent Recommendation issued by NTSB to PHMSA January 3 2011
- PHMSA Advisory Bulletin 11-01 issued Jan 10, 2011
- PG&E *"has not been able to produce documentation on the origins of the pipe, the installation of the pipe, or the early inspection of the pipe,"* NTSB Chair D Hersman (1/27/2011)

Record Keeping

- Operators must review and scrutinize pipeline infrastructure documents and records, including but not limited to, all as-built drawings, alignment sheets, specifications, and all design, construction, inspection, testing, material manufacturer, operational maintenance data, and other related records, to ensure company records accurately reflect the pipeline's physical and operational characteristics. **These records should be traceable, verifiable, and complete to meet §§192.619 and 195.302.** Incomplete or partial records are not an adequate basis for establishing MAOP or MOP using this method. If such a document and records search, review, and verification cannot be satisfactorily completed, the operator may need to conduct other activities such as in-situ examination, pressure testing, and nondestructive testing or otherwise verify the characteristics of the pipeline when identifying and assessing threats or risks.

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Multiple Legislative Initiatives

- California Specific Statute Bills (5 in play)
- Senate Bill sponsored by Sen Boxer
- Senate Bill 275 sponsored by Sen Lautenberg
- House Bill version sponsored by Energy and Commerce Committee
- House Bill version sponsored by Transportation and Infrastructure Committee